HEATING & VENTILATING

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

Engineering Gas Conversion Burner Installations

1—Surveying the Heating Plant

By ALFORD G. CANAR†

The Peoples Gas Light and Coke Company of Chicago has made an impressive record in promoting the installation of gas conversion burners in its territory, having added over six thousand such units to its lines in one year. The engineering experience of this utility with its large number of jobs, covering all types of systems, is summarized in this article, the first of a series on the subject by Mr. Canar.

PRIOR to the advent of the conversion burner, gas designed equipment had control of the gas house-heating field, such as it was. Gas rates were comparatively high even though special space heating rates were devised, and installation costs of gas designed equipment were high, hence it was no easy matter to add any appreciable number of new customers year after year. There probably was as much sales resistance to the installation cost as to operating costs.

Laboratory tests showed efficiencies of anywhere from 70 to 77% for conversion burners in boilers, depending on the particular boiler they were tested in. Since gas designed boilers usually show from 80 to 82% efficiencies under similar tests it was concluded that the conversion burner could readily be used in a coal boiler and all that was necessary was to add 10% to the gas designed operating cost estimate; then install a burner, which had a gas capacity sufficient to handle the estimated load of the particular job; next, size the flue on the basis of allowing 1 sq. in. of flue area per 7500 B.t.u. of gas burned per hour, choose the nearest commercial size, and install a conventional draft diverter; place the estimated hourly gas rate on the burner, adjust the air by observing the flame, and then assume that the customer would receive satisfactory heating service at a cost of only 10% above what it would cost if he used gas designed equipment.

What optimists we were!—but our optimism was short-lived, because four out of five jobs didn't get along so well. The customers complained of slow heating up in the morning, insufficient heat in the colder weather especially, high operating cost, cold 70, etc., the predominating complaints being insufficient heat and high operating costs.

This situation had to be met and as more and more of these jobs were analyzed and studied it became evident that better engineering was necessary prior to the installation and that considerable engineering was necessary after the installation of the burner in order to obtain a satisfactory job.

Application of sound engineering principles to conversion burner work will permit a satisfactory job in almost all cases. The exceptions are those where there is a poor boiler or a poor system.

Engineering Prior to Installation

Pre-installation engineering involves the following procedure: 1—survey of premises; 2—calculation of heat loss; 3—survey of heating system; 4—survey of the design of boiler or furnace; 5—burner selection; 6—control selection; 7—calculation of approximate required gas consumption; 8—sizing of flue pipe; 9—consideration of water coils and heat exchangers.

Good engineering prior to the burner installation is essential in order to obtain a satisfactory job. The better the engineering prior to the installation, the less the engineering required after the installation.

Heat Loss

The first essential is a careful survey of the entire premises which are to be heated. Calculation of heat loss for the particular range of design temperatures peculiar to the locality (0° to 70° in Chicago) must be made with especial care so as to include all the known peculiarities of construction of the building,

†House-Heating Division, The Peoples Gas Light and Coke Co., Chicago.

due consideration being given to weatherstripping, looseness or tightness of windows, storm windows, insulation, depreciation of construction which permits greater infiltration and cooling effect, and so on. Since the heat loss is the basic calculation on which many other considerations depend, it is important that this calculation be made as carefully as possible.

Survey of Heating System

Individual radiators and the total radiator surface installed should be checked against the required radiator surface as calculated from the heat loss to determine the seriousness of radiator shortage if such shortage exists, and it usually does in the great majority of cases. The homeowner or occupant of the house should be questioned whether some rooms heat better than others. Such information will assist the engineer in checking the heating system. The piping design should be checked to observe whether or not the mains are of proper size, that the risers and branches leading to the radiators are of proper size for the standing radiators they supply, that returns are of adequate size and design, and whether or not the piping permits the bypassing of any radiator. The idea is to determine as nearly as possible whether the circulation of the heating medium will be good, fair, or poor. This is important because a job with poor circulation and adequate radiator capacity will be more costly to operate than one with good circulation and adequate radiator capacity.

With steam, vapor, and vacuum systems all air valves on radiators and returns should be checked to determine whether or not they will function properly or are leaky. Air vents on returns are often incorrectly placed so that they will not properly eliminate air even though they may be working properly otherwise. Such air valves are usually found on fittings but should be connected to the top of the fitting and not off the side if they are to perform properly.

Warm Air Systems

With warm air systems the individual leaders should be checked for proper size and the total leader area determined. The most glaring faults in warm air jobs occur as regards the return air. Few plants have adequate return duct area and proper distribution of return grilles to warrant good circulation. A large number have only one return and this usually connects to one grille in the center of the house. Such a job will have poor circulation even though the size of the return is ample. The best practice today calls for at least as much return area as leader area, which should be 110% of the leader area where two returns are used and 120% where three returns are used. Reference here is to gravity systems.

Connection of returns to the furnace casing is also important. Return boots should not extend above the grate line of the furnace but often do. Boots should also flare out where entering the casing so as to distribute return air to a greater portion of the base of the furnace. Boots which do not flare toward the casing, especially where only one return is used, permit channelling of the air along only one side of the furnace. Return ducts should pitch toward the furnace so that return air may roll back by gravity and not depend upon a vacuum created by the rising of the heated air inside the furnace.

Warm air leaders should, of course, pitch upward toward the register boots and the fewest possible number of turns used.

These factors all influence the circulation of the air in the system and the more faults the slower the circulation. Such faults should be pointed out to a prospective customer and the correction of these faults urged as much as possible, because intermittent heat has a way of indicating these faults prominently. Steady firing, as with solid fuel, tends to keep these faults covered up to some extent because some air circulation is going on all the time and circulation never comes to a complete standstill as it does with intermittent firing. With intermittent firing all the faults of the system provide resistance to circulation; hence a longer initial firing period is required to get circulation started and accelerated.

Whether a system is steam, hot water, or warm air, the speed of circulation of the heating medium has a direct bearing on the operating cost. The problem of obtaining the best possible circulation in any particular case is an engineering one which will be dealt with later.

Survey of the Heater Design

Sectional cast iron boilers, according to one of the leading manufacturers, are designed to have about 65% of the total heating surface in the firepot (direct heating surface) and the balance of 35% in the upper flue passages or beyond the firepot (indirect heating surface).

This ratio is subject to some variation with other makes of boilers. Nevertheless, it indicates that the larger portion of the heating surface is contained within the firepot. The ratio remains approximately the same regardless of the number of sections in the boiler. Gases most generally leave the firepot at the rear, but sometimes between all the sections and occasionally at the front. The upper flue passages vary in height and width from about three inches up.

Smokeless types have a hanging water leg from one or two sections near the rear under which the gases must dip before entering the upper flue passages. Other types have a water grate at some distance above the usual grate, which makes them downdraft to a little greater extent than the smokeless type.

All these features of design must be seriously considered from an engineering standpoint for a prospective conversion burner installation.

Round Boilers.—The same ratio of firepot or direct heating surface to upper flue passage or indirect heating surface does not hold true generally for round boilers because of the variation in upper flue passage heating surface depending on the number of upper or intermediate sections. A four section round boiler, consisting of an ashpit, firepot section, crownsheet section,

and dome section, has a much higher proportion of firepot heating surface to total heating surface than a boiler of the same diameter, which has two, three, or four intermediate sections. However, the less the proportion of heating surface beyond the firepot the more effectively the firepot heating surface and the flue passage heating surface must be used in order to obtain the best possible results when firing with gas. The effectiveness of heat transfer in the firepot depends not only on the amount of heating surface available but also on the temperature differential, which in turn depends directly on the way in which the heat generated by the burner is applied to these heat absorbing surfaces. The effectiveness of heat transfer beyond the firepot depends on:

1—Amount of heating surface available.

2—Temperature differential between the gases and the water in the boiler in contact with the heating surface, which is considerably less than in the firepot.

3—Design of the flue travel and whether or not the gases are evenly distributed over all of the heating surfaces and how intimately the design of the boiler permits effective scrubbing action of the gases on the heat absorbing surfaces.

Furnaces—Warm air furnaces vary greatly as to the ratio of firepot to upper flue passages heating surface. However, on most of them the firepot heating surface will be greater than the balance. On some, like those which consist of only a cylinder with an outlet to the flue, the firepot or combustion chamber heating surface amounts to practically 100%.

The commonest type of furnace is the cast iron circular radiator type. The radiators may be of either cast iron or steel and vary considerably in size, which naturally will vary the ratio between firepot and radiator heating surface. Other types may have crowfoot radiators or be of tubular design.

Steel furnaces usually have a rear radiator beyond the combustion chamber through which the gases pass on their way to the flue outlet. These rear radiators may contain a vertical baffle plate which forces the gases to pass downward on one side of the radiator and then upward on the other side, in which case the flue outlet is taken off the upper rear end of the rear radiator. Such furnaces usually have an indirect damper built into the upper portion of the vertical baffle plate. Such a damper must be closed when firing with gas because otherwise the entire rear radiator heating surface would be bypassed by the hot gases. Other steel furnaces have double flue outlets off the rear radiator. The upper flue outlet should be blocked shut and the flue connected only to the lower outlet so that no heating surface is bypassed.

Effect of Firebrick Linings

Most steel furnaces have the firepots lined with firebrick of a thickness from 1½ to 3 in. The object of the lining is to prevent oxidation, carburization, and warping of the steel by contact with the incandescent solid fuel. Cold firebrick is a fairly good insulator so far as heat conduction is concerned. However, the hotter the firebrick the better it conducts heat. Therefore, under normal conditions of solid fuel firing these linings are very hot and thus become fair conductors of heat. Intermittent firing, as with gas, permits the lining to become practically cold after the gas burner has been shut off for a while and after the burner comes on again a certain amount of burning period must elapse before the lining becomes sufficiently hot to again become a fair conductor of heat. In the meantime a greater flue loss results because the furnace absorbs less heat and at the same time the circulation of the heating medium is slow and the heat delivery to the house is slow and inadequate; but when this lining has been removed, these adverse factors are removed and a much better operating job results.

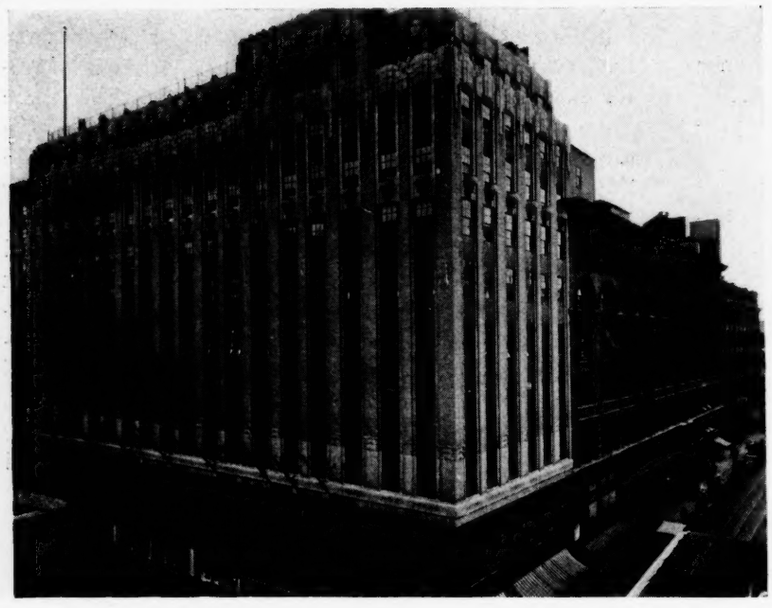
Experience has shown that in an appreciable number of cases, where approximately during one-half of the heating season the plant was operated with the firebrick lining in the furnace and the other half with the lining removed, the operating cost was reduced an average of 12.5% after the lining was removed. Therefore, these linings should be removed and burners should be used which will not permit the gas flames to directly contact the steel firepot walls else deterioration of the steel will result. Thus, avoid using burners in this type of furnace which have refractory baffles which lean against the firepot wall. To use such a burner in a steel furnace where the firebrick lining has not been removed results in a burning up of the burner head within a few months because of the overheating of the burner head by being confined closely between two walls of refractory material.

Furnaces having indirect dampers, whether of cast iron or steel construction, which permit the gases to make a short cut to the flue when open and permit use of all the heating surfaces when closed, will show a flue temperature from 100° to 200° lower when these dampers are closed. The same condition holds true with furnaces having double flue outlets. In these latter, the hot gases have a shorter travel when the flue is connected to the upper flue outlet than when connected to the lower flue outlet. The heating surface is bypassed as much as 45% on some furnaces when such indirect dampers are left open or when the flue pipe is connected to the upper of two flue outlets.

It is a good policy, with downdraft furnaces and boilers, to install a small vent line (about ¾ in.) from the high point of the flue passage so as to vent any possible gas pocket to the chimney.

Since many cast iron furnaces encountered are very old and probably have not been kept in good repair, it is advisable to make a leakage test on all cast iron furnaces regardless of age to determine whether or not any points of leakage exist either by cracks in castings or at cemented joints. Necessary repairs when cracks in castings are found should be made. When leakage occurs otherwise the furnace should be entirely recemented. Such precautionary measures are advisable to avoid future grief.

Next month's installment of this series will deal with the selection of the gas burner and controls.



Bloomingdale's department store, one of the first air cooling installations using a water vapor machine.

Air Conditioning with the Water Vapor Machine†

By RAYMOND R. BENNETT

DURING the early part of 1934 one of the first air conditioning systems using a water vapor machine for cooling was installed in Bloomingdale's department store, Lexington Ave. and 59 St., New York. Accurate records were kept of the operation of both the cooling unit and entire system for 20 days during the hottest part of the summer of 1934. The data revealed that not only is the water vapor machine safe and easy to operate, but also that it has a low operating cost.

A water vapor refrigerating unit operates on the well known principle that water boils at a temperature corresponding to the pressure to which it is subjected. For example, water under atmospheric pressure boils at 212°. If water is placed on a mountain top at an elevation of say 28,000 ft., it will boil at 160°. It is evident that if a sufficiently low absolute pressure or a high enough vacuum is maintained over a body of water, it would boil at a lower temperature. To reach a boiling point of 48°, which is approximately the temperature of the water required for air conditioning work, it is necessary to reduce the pressure to 0.34 in. of mercury absolute. Hence, if water was sprayed into a vessel where a vacuum of 0.34 in. of mercury was maintained, part of this water would boil, extracting its latent heat of evaporation from the rest of the water and cooling it to 48°. As the heat required to convert 1 lb. of water into steam is 180 times as great as the heat given up by 1 lb. of water in cooling from 54° to 48°, only a small fraction of the water entering the vessel will flash into steam. About 1% of the water fed to the vessel will flash into steam for every 10° difference in cooling water temperature. The vapor formed must be continuously removed to maintain the vacuum.

The space conditioned in the Bloomingdale store is made up of a basement and a first floor in the east wing of the building. As is usual in most department stores, the walls are irregular and the floors crowded. Because of the type of construction it was necessary to install separate cooling units in place of a central air washer system. Water at 48° is piped from the water vapor machine to the various cooling units.

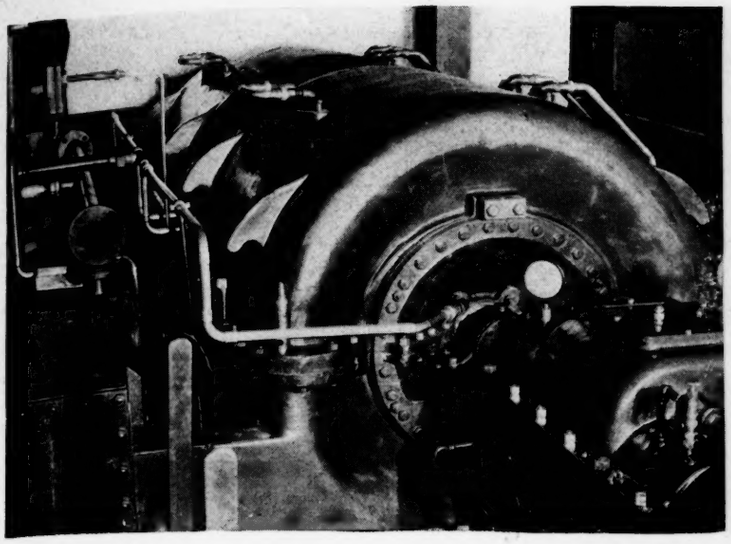
Previously the section of the basement that is conditioned had to be closed off during the summer because of the excessive heat. Approximately 262,000 cu. ft. of space with a floor area of 1300 sq. ft. in the basement and 540,000 cu. ft. with a floor area of 17,200 sq. ft. on the first floor are cooled.

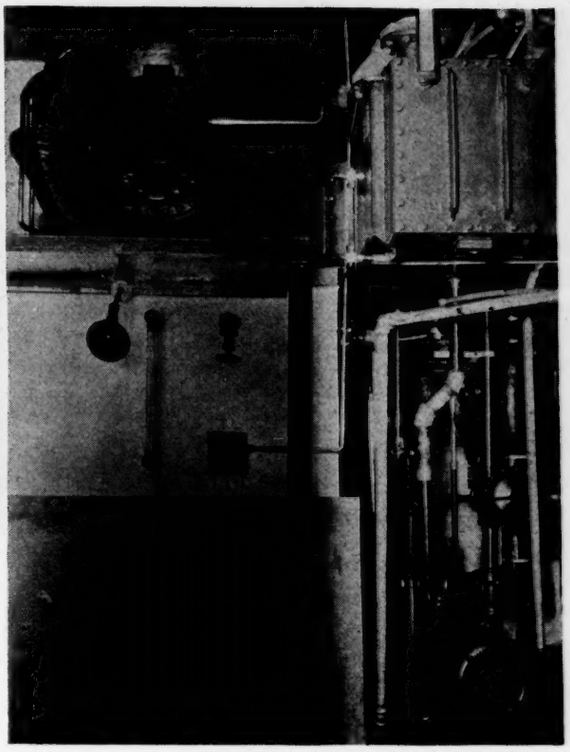
In making the calculations for heat gain it was assumed that the store should be cooled to 80° dry bulb and 67° wet bulb when outside conditions were 95° dry bulb and 75° wet bulb. Enough capacity was to be guaranteed to take care of 2,350 people—750 in the basement and 1,600 on the first floor.

It was found that the major loads in the cooling of a department store are the lights and the human load. These remain comparatively constant throughout the year, increasing the cooling to be done in warm weather and decreasing the amount of heat during the winter season. The sensible heat gain in the basement was found to be 419,000 B.t.u. per hr., and the latent heat 138,500 B.t.u. per hr., making the total heat gain 557,500 B.t.u. per hr. On the first floor the sensible heat gain was 871,000 and the latent heat 296,000, for a total of 1,167,000 B.t.u. per hr.

Assuming a 22° rise in temperature the quantity of air necessary for the basement was found to be 20,000 c.f.m. On the first floor the volume of the air necessary was 36,500 c.f.m. Since it was decided to recirculate two-thirds of the air, approximately 6,700 c.f.m. of outside air has to be supplied to the basement every minute and 12,200 to the first floor. The heat of the outside air amounted to 640,000 B.t.u. per hr., making the total heat removed for the basement and first floor 2,364,480 B.t.u. per hr. This is equal to 197½ tons of refrigeration.

†Abstracted from a thesis submitted by the author to the Polytechnic Institute of Brooklyn, 1935.





(Above) Two centrifugal compressors force the water vapor from the evaporator into the condenser. They are of the water cooled type and operate in parallel. (Right) The evaporator serves as a base for the vapor compressors. At the upper corner is the condenser which liquefies the vapor removed from the evaporator.

The vapor machine selected was one guaranteed to develop 190 tons of refrigeration while cooling the water from 62½° to 48°. The machine is made up of an evaporator, two vapor compressors and a condenser.

The Evaporator

The evaporator is a rectangular steel enclosure which also serves as a base for the compressors, step-up gear and motor. In one end of the enclosure, underneath the compressors, is located a pressure tight compartment which is the evaporator. This compartment has a large flanged opening in the top, to which the intake connection of the vapor compressor is bolted. The water enters the cooler through a flanged connection in its side, passes through a float valve which controls its rate of admission, and through a spray header into the various spray pipes. The spray from the pipes is extremely fine so that evaporation may take place more readily. At the bottom of the box there is an outlet to the chilled water pump.

The Compressor

Two vapor compressors of the water cooled type are connected in tandem and operate in parallel. The compressors are mounted on the evaporator. The impellers carry the vapor from the cooler, compress it, and deliver the compressed vapor to the condenser. Each half of every interstage diaphragm is cored for individual cooling water circuits. Special packing glands and sealing rings are used on the shaft to prevent leakage of air into the evaporator.

The compressor is driven at a speed of 9,675 r.p.m. by a 200-hp. motor through step-up gears.

The Condenser

A multi-pass surface condenser is used to condense the compressed water vapor. The pressure in the condenser is approximately 1.7 lb. per sq. in. absolute and will condense steam at a corresponding temperature of 96°. The condenser cooling water, which is taken from the city main, enters at about 70° and leaves at 89.5°. In the condenser the steam gives up to the water the heat which it has absorbed in the evaporator, plus the heat of compression. The refrigerating unit is simply a heat pump removing heat from the chilled water, and delivering this heat to the condenser water. The water leaving the condenser discharges into the sewer.

Safety Devices

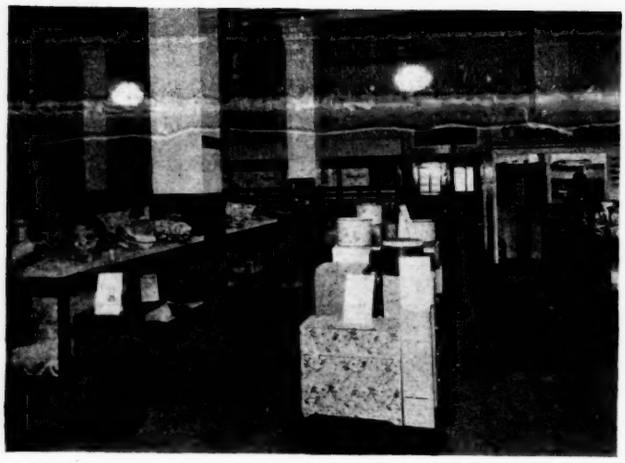
A high water atmospheric relief valve is installed under the cooler compartment to guard against the flooding of the unit, which might result in damage to the compressor. This valve is hung underneath the seal water supply box and is so arranged that it is ordinarily closed, but will open if the water level in the evaporator rises high enough to lift the ball float. When open, it will permit air to rush into the cooler, thus breaking the vacuum in the entire unit and putting a sudden overload on the compressor. The motor circuit breakers will trip, bringing the compressor to a stop.

Air Conditioning Units

Cold water at approximately 48° is supplied to 11 surface cooling units of which there are five in the basement and six on the first floor.

Each unit air conditioner consists of a set of motor-driven fans and a cooling coil through which the cold water is circulated and over which the air is moved, all enclosed in a suitable housing. The air is filtered before entering the unit. A drain is provided to take care of the water condensed from the air.

Fans are of the centrifugal type with blades curved in the direction of rotation. They are driven by an



(Left) A section of the first floor showing one of the distributing ducts. (Right) Air conditioning unit as installed in furniture department. Unit is made up of fans, motors, filters, cooling coils, and a drain.

electric motor through a belting arrangement. The smaller units have two fans, while the larger units have three. The motors used are of 1.5 and 3 hp., running at a constant speed of 765 r.p.m.

Cooling coils are made of copper tubing, wound with fins of copper. Finned coils are used because they increase the heat transmissive surface.

Filters are made of glass wool and may be removed to be cleaned. The filters are connected to the fresh air intake on all units.

Each unit contains a separate and complete set of controls. These controls consist of a thermostat and a hygrostat. The thermostat controls the position of the bypass damper, closing the damper when the temperature is too high and opening the damper when the temperature drops. The hygrostat controls the amount of water entering the unit

Operating Data

A summation of the operating data recorded during the period from July 6, 1934 to August 3, 1934 is given in the table. The second and third columns show the average outside conditions for each day in that period during the hours between 9 a.m. and 5 p.m., while the next two columns show the corresponding inside conditions maintained. The next column lists the average number of people in the conditioned area. The average tonnage developed by the water vapor machine is given in the seventh column. It should be noted that on July 12 the low tonnage developed was caused by the machine operating only 3 hr. during that day. The next three columns list the power consumed by the various units of the system. The last column gives the water consumption, that is, the amount of cooling water used by the refrigerating condensers. As is to be expected this figure is proportional to the tonnage developed by the compressors.

The cost of operation per hour during this 20-day period was found to be $3.60. This figure, however, cannot be taken as the average cost of operation over the entire summer for it must be remembered that it was obtained from tests conducted during the hottest portion of the summer. The average cost should be somewhat lower.

The water vapor refrigerating equipment was supplied by Ingersoll-Rand Co., the consulting engineer being Edward Ashley, the contractor, Riggs-Distler Co., and the consulting engineer for the contractor, Walter L. Fleisher.

Date	Average Outside Conditions		Average Inside Conditions		Average No. of People in A.C. Area	Average Tonnage Developed	Power Consumed-Kw.-Hr.			Water Consumed Cu.Ft.
	D.B.	W.B.	D.B.	W.B.			Pumps	Refr. Mach.	A.C. Units	
July										
6.....	88.8	78.3	78.8	70.9	250	152.2	138	1000	92	14,000
9.....	81.3	65.2	75.7	63.9	269	95.0	121	700	84	10,330
10.....	79.7	63.4	75.3	63.0	249	72.0	120	600	79	6,600
11.....	76.5	64.0	74.0	62.6	277	75.0	110	600	94	6,550
12.....	76.1	65.2	77.0	66.0	263	29.1*	48	180	33	2,830
13.....	77.5	69.5	74.8	66.3	263	97.5	117	700	91	8,300
16.....	77.3	68.6	75.8	65.7	278	92.8	121	700	91	8,280
17.....	81.0	61.9	75.4	63.4	282	67.3	120	600	93	6,720
18.....	84.5	63.5	75.8	64.0	279	64.3	120	500	92	6,100
19.....	83.7	72.6	77.5	68.2	244	99.5	131	700	91	8,540
20.....	85.2	75.4	77.9	70.4	243	130.5	119	800	88	12,400
23.....	78.9	61.8	77.0	64.3	245	66.4	119	500	91	7,130
24.....	76.3	64.7	76.0	64.1	245	76.2	115	500	83	9,030
25.....	77.8	73.0	76.2	69.0	236	105.2	129	600	102	11,250
26.....	84.8	75.4	77.5	69.9	359	132.5	119	800	84	13,950
27.....	84.3	75.5	78.4	66.8	233	123.0	121	800	86	10,650
30.....	77.8	71.2	76.5	66.5	257	84.7	109	600	84	7,260
August										
1.....	82.3	65.8	76.4	66.6	244	85.7	120	700	88	8,400
2.....	78.6	68.2	76.5	66.7	261	88.5	120	700	89.5	8,530
3.....	84.2	71.1	77.0	68.1	253	98.0	121	700	87	8,920

**Only 3-hr. operation.*

Forecasting Degree-Days May be Possible

according to theory advanced at Smithsonian Institution. Research indicates temperature fluctuations on 23-year cycle. Coming winter would be slightly warmer than normal in New York and Chicago

THE dominating influence of a major solar radiation cycle of approximately 23 years on a wide variety of terrestrial phenomena, including temperature, is demonstrated in long-continued studies of far-reaching significance by Dr. Charles G. Abbot, secretary of the Smithsonian Institution. This development is of importance to engineers and estimators dealing with fuel consumption.

A detailed account of these researches, constituting what may prove to be one of the most significant advances yet made in the direction of weather forecasting over extended periods, was issued by the Institution during August. It includes a report of a large number of actual weather forecasts based on the 23-year cycle hypothesis, and the extent of their verification for 1934. They were remarkably successful, especially when the difficulties and complexities of the problem are taken into consideration.

Briefly, the results are as follows:

Temperature and precipitation at numerous points scattered over the surface of the earth show many features which approximately duplicate the conditions at the same points 23 years before.

The water levels of the Great Lakes, reflecting the fluctuating precipitation in their drainage area, show a regular 23-year cycle and a strong suggestion of an even more significant double cycle of 46 years. The same 23-year cycle is found in the low-water level of the River Nile for more than 600 years. The 23-year cycle is demonstrated in the abundance of the catch of cod and mackerel in the North Atlantic. The 23-year cycle is shown by the varying widths of tree rings at numerous localities and over hundreds of years. The same cycle apparently has been operative through many millions of years, as is demonstrated by the thicknesses of the varves left in the rear of retreating glaciers in the ice ages and in the fluctuations of lake levels during more remote periods.

The discovery of the cycle came as a culmination of years of intensive observation and analysis in an effort to discover the relationship between solar radiation and the weather. It was first announced by Dr. Abbot before the National Academy of Sciences in the fall of 1933. For 15 years Smithsonian observers stationed on desolate mountain tops had been making daily measurements of the heat of the sun.

At first the solar heat seemed to fluctuate in a purely haphazard manner with no discernible regularity. With more and more accurate observations, more and more delicate instruments, and the use of improved formulae and methods for mathematical analysis Dr. Abbot was gradually able to unravel the tangled threads. He reached the point where he was able to predict quite accurately what was going to happen on the sun.

Now a variation in the heat output on the sun should, and undoubtedly does, cause a difference in the temperature of the earth which, in turn, would be reflected in rainfall. The exact effect, however, would depend largely on conditions on the earth itself. The problem was to tie the solar changes and the terrestrial changes together and to see if they were large enough to be significant.

Dr. Abbot found that there were 12 recurring periodicities in the solar radiation output and was able to evaluate them. Then he added them and was able to reproduce the original solar changes for the whole 15 years within an average monthly discrepancy of one-fifth of one percent Twice he made and published predictions of the sun's variation for two years, and his predictions were confirmed with considerable precision.

Dr. Abbot found all of these 12 solar changes giving their effects separately and in significant magnitudes to weather of all parts of the g'obe. But, like all scientists who have tried to trace periodicities in weather, he ran into phase reversals. Sometimes a periodicity in the weather would follow a certain type of variation for many years, and then reverse itself and act in just the opposite manner for long intervals.

The next step was the arresting discovery that the alterations of the phases of periodicities caused by the sun in the weather take place abruptly at multiples of 23 years measured from January, 1819.

The net result, as announced by Dr. Abbot before the National Academy, was that weather the world over fluctuated—specifically for localities because of local conditions—in a great 23-year cycle which was essentially a double sunspot cycle. Hitherto, to simplify the problem, he has dealt only with 5-month smoothed data. That is, for March departure from normal temperature he would use one-fifth of the sum of departures of temperatures for the first five months of the year. *Subject to that limitation, if the temperature of the city of New York was below normal during the month of January 1912, it could be expected, all other things being the same, to be below normal in January 1935.* In other words, every 23 years the weather in any particular part of the world tended to repeat itself.

This did not mean, of course, that the repetition would be exact from day to day or from month to month. It did not mean — and this cannot be too strongly emphasized—that if the average temperature of New York City in January 1912 was 10° below normal it certainly would be 10° below normal in January 1935. It did mean, however, that the particular locality could expect colder than average weather culminating not far from the month of January 1935. Solar variation, after all, is only one factor in weather, howsoever dominating it may be, and moderate displacements of effects sometimes occur in the same direction for many months at a time.

Following the announcement of the discovery Dr. Abbot set to work at once making actual temperature and rainfall predictions for the three succeeding years. Altogether he made 66 forecasts for different parts of the United States. Once the graphs were drawn they were locked up. The forecasts for 1934, however, have been checked against the actual weather for the entire 12 months. They demonstrate the reality of the 23-year cycle.

Twenty-seven percent of them he calls "excellent." The predicted curves, for example, of the 1934 temperature of Helena, Mont., and of the 1934 rainfall of Chicago fitted the actual curves almost exactly.

Forty-two percent of the predictions Dr. Abbot describes as "good." They predicted surprisingly closely the general trend of the weather without achieving as extraordinary exactness as the class called "excellent" for both temperature and rainfall. Seventeen percent of the forecasts showed half of the year a fair fit with actual conditions, but deviated widely the other half. Fourteen percent, Dr. Abbot admits frankly, were bad. Apparently they show no relationship at all to actual conditions.

Dr. Abbot stresses the point that the forecasts are purely experimental, that they are pioneer efforts in largely unexplored territory, and that they must be considered rather as efforts to clear a path through the tangled maze of solar-terrestrial relations rather than as practical forecasts.

Applying Dr. Abbot's theory to a simple heating problem, it would appear that the coming winter (1935-36) in Chicago should be about 2½% warmer than normal and about 7½% warmer than a normal season in New York.

Liquid Adsorption Air Conditioning Systems†

By W. L. FLEISHER

ALTHOUGH such systems as the silica gel, alumina, or activated carbon systems hold some interest for those interested in steam regeneration, the relatively high surface tension or electric potential of the surfaces presented requires temperatures to set up evaporation that are above the average steam pressure available with most district heating utility companies. Gas or oil is preferable as a regeneration agent in the solid colloidals used for dehydration. It is true that silica gel, for instance, if properly used can produce dehydration effects below the average eutectic points of liquid adsorbers. But for most purposes, both comfort and industrial, the conditions that can be obtained with lithium halides are eminently satisfactory.

Practically all salt solutions have the property of adsorbing or condensing moisture from a gas. The amount depends on the character of the solution, its gravity, temperature and viscosity. One of the best known dehydraters, calcium chloride, for instance, has been long known for this property. Its characteristics, however, present a limiting factor of about 30% relative humidity, so that the resultant dew point of air brought in intimate contact with calcium chloride is usually too high for comfort work without further refrigeration.

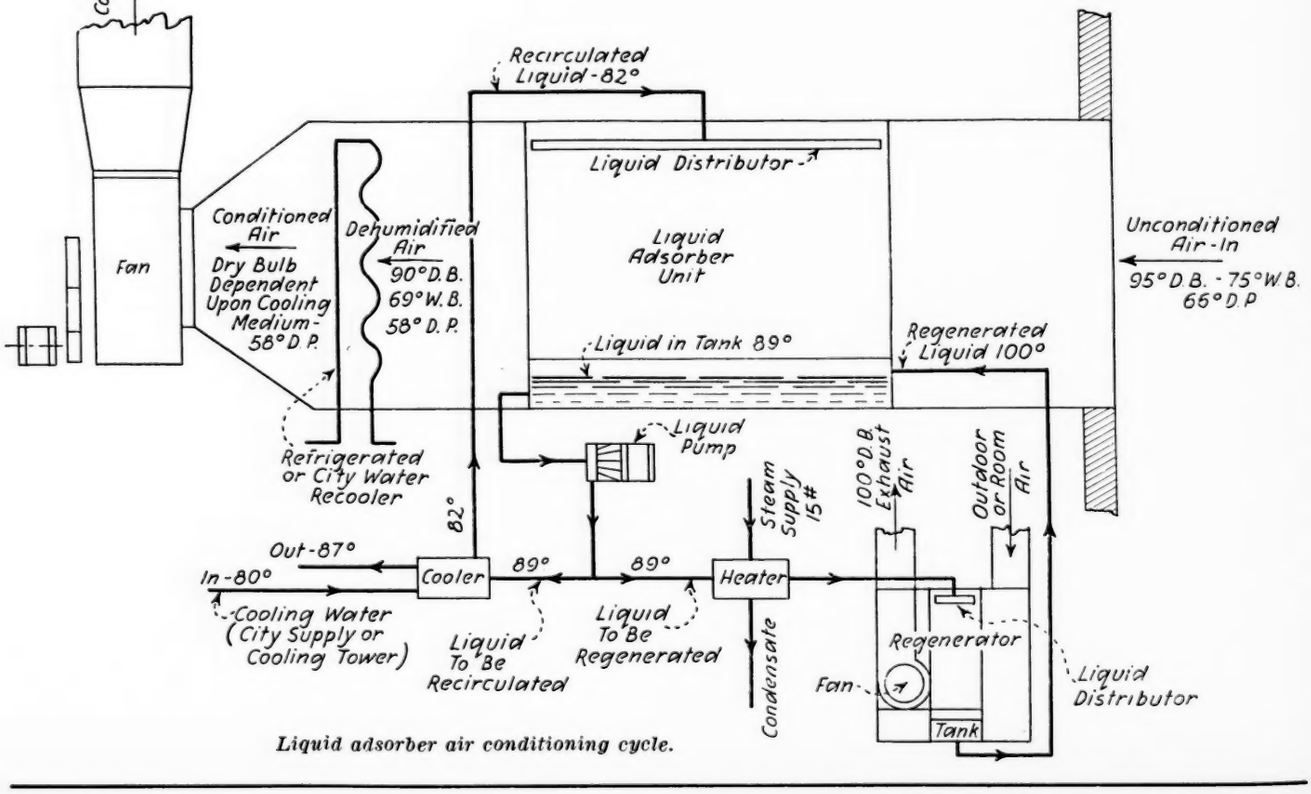
Lithium chloride having a lower vapor pressure and freezing point at the desired air conditioning temperatures, thus lends itself to dehydration admirably.

The cycle of solid dehydraters or adsorbers and liquid adsorbers are fundamentally the same.

The liquid adsorber is brought in contact with air having a certain vapor pressure due to the moisture or water vapor that is in it, and the chloride, either sodium, lithium, calcium, or whatever is used, having a lower vapor pressure, adsorbs moisture in the form of water from the water vapor that is in the contacting air. Thermodynamically, it is definitely possible to measure this change and to know definitely that a change of state takes place because of the fact that there is a definite rise in temperature in the liquid adsorbing the moisture, which is definitely a function of the amount of water vapor condensed from the air stream. Of course, the liquid adsorber, contrary to the solid adsorber such as silica gel, takes on two functions: one, as an adsorber, and that adsorption, as has been stated, tends to create a rise in temperature; on the other hand, the mass of liquid in the adsorber tends to keep down the rise in temperature, so that by cooling the adsorber below a certain temperature, a definite temperature can be maintained in both the liquid and the air, which is a function of the heat balance between the total heat of the air and the total heat of the liquid.

Adsorption of moisture by a liquid adsorber weakens the concentration of the liquid so that its adsorbing capacity is reduced and regeneration, or the driving

†A paper presented by the author before the 26th annual convention of the National District Heating Association, Philadelphia, June 11-14.



Liquid adsorber air conditioning cycle.

off of the excess moisture in the liquid, must be performed, just as the driving off of the liquid adsorbed by a solid adsorber must be accomplished. However, with a liquid adsorber a very definite condition can be maintained; that is, a condition of density, by continuously withdrawing a certain small portion of the total liquid for intensive concentration and the concentrated liquid added to the mass of the liquid continuously, without varying to any marked degree the vapor pressure of the total mass. This method of continuous regeneration and re-concentration tends to hold the relative humidity of the leaving air always at a very definite point.

There are two methods of regeneration. One is the boiling off of the excess moisture by raising the temperature of the adsorbing liquid to above the boiling point of the particular concentration. As the salt in the solution does not vaporize, it is not carried off in the boiling process. The only care required is that in the small amounts of liquid diverted to the regenerator for concentration, too much moisture is not driven off, occasioning freezing or solidification of the salts, or solids.

The second method of regeneration which lends itself particularly well to ordinary low pressure heating systems, where steam pressure of about 12 lb., corresponding to a temperature of 242°, is to raise the temperature of solution with ordinary steam coil interchangers to about 225°, and then to pass the solution at this temperature over various types of scrubbers, over which ordinary air is passed. The increase in temperature of the liquid adsorber tends to increase its vapor pressure to such an extent that there is an exchange of vapor between the liquid adsorber and the air, as well as an equalization of temperature between the air and the liquid adsorber, so that the air is capable of taking up part of the moisture from the liquid adsorber to increase its density and to carry this excess moisture out into the atmosphere with the leaving air.

After this vaporation has taken place, the highly concentrated, hot liquid adsorber is taken through an interchanger through which the water used in cooling the main solution can be re-used to reduce the temperature of the concentrated solution to a point where it may be thrown back into the main solution tank at a slightly higher temperature than the main body of the solution. As approximately only 10% of the solution is regenerated continuously, a difference of five to ten degrees in the concentrating solution only creates a rise of a degree or less in the main body of the adsorber, so that its effect on increasing the temperature of the air to be dried is negligible.

As can be seen, there are two conditions of continuous operation which have a tendency to raise the temperature of the liquid. One is the adsorption of vapor from the air, which, through a change of state, changes the latent heat of the vapor adsorbed to sensible heat, to raise the temperature of the liquid and consequently, the temperature of the air; secondly, the necessary heat added to the regenerator liquid in order to re-evaporate and carry off the excess moisture which has been condensed in the first stage.

In the regeneration process, the air currents in this method have a tendency to carry away the excess heat of evaporation. In the first stage, that is, the main stage of adsorption, the temperature of the main body of liquid is continuously cooled, and the excess heat carried away by some type of interchanger, through one part of which either cooling tower or city water is utilized. Of course, this water may be refrigerated, but under most conditions that is unessential. With the ordinary liquid interchanger, using cooling tower water, the maintained condition of the liquid and the air can be kept at a point very close to the prevailing wet bulb, possibly within five, and certainly within 10°.

From the standpoint of public utilities, this method of air conditioning has many interesting points. The steam required for regeneration, in which the district steam utilities are principally interested, is about 1.4 lb. of steam per pound of water adsorbed by the liquid adsorber. Assuming approximately 1000 B.t.u. of heat required to evaporate 1 lb. of water, the other 0.4 lb. is required to raise the percentage of adsorber which is regenerated from the temperature of the main body to the temperature of regeneration. This, as can readily be seen, varies, first, with the temperature of the main body of the adsorber and, secondly, with the temperature to which the regenerated portion is raised; also, in a minor degree, with the temperature of the air used for carrying away the moisture and equalizing the temperature of the regenerated adsorber.

The quantity of water required for interchange is a function of the temperature of the water. It must be sufficient, however, to prevent the latent heat adsorbed from raising the main body of the liquid above the temperature desired in the leaving air. This usually means that the heat to be picked up by the interchange water must be equivalent to the latent heat given up in adsorption.

The power required to operate such a system is approximately the equivalent of the power required to operate an ordinary dehumidifier. The cooling water required is the equivalent of the water required for condensing purposes in an ordinary refrigerating system. Therefore, the comparison of operating costs is the comparison between the cost of steam and the cost of electricity, the amount of steam required for regeneration being about the equivalent of the power required for driving the essential refrigeration apparatus.

The initial cost of a liquid adsorber system should not run much more than the cost of an ordinary refrigerated air washer system, exclusive of the refrigerating apparatus. In other words, the refrigerating apparatus, to a major extent, should be saved in a liquid adsorber system. Without the addition of artificial refrigeration, dry bulb temperatures as low as can be obtained with artificial refrigeration are difficult to obtain, but a relative humidity lower than ordinarily can be obtained with artificial refrigeration can be obtained to give results which should conform in comfort to the lower dry bulb temperatures.

Interior of Mapparium, a huge special map of glass.

Air Conditioned "Mapparium" Latest Contribution to Geography

A UNIQUE addition to the art of cartography is the huge "Mapparium," as it has been named, recently completed at the Christian Science Publishing Society's building, Boston, and thrown open to public visitation. It is a huge hollow globe of glass, forming a spherical map of the entire world shown in its true proportions which the spectator views from inside. It is a comprehensive presentation of the correct relationships of the divisions of the earth's surface, shown graphically in color, and housed in an air conditioned room a little over two stories high.

The "Mapparium" is 30 ft. in diameter and is bisected at the equator inside by a massive transparent glass platform on which the spectators stand while viewing the different portions, above, below, and around them. This platform has been tested to many thousand pounds, so that it will hold the weight of all the people who can crowd upon it.

By means of this hollow sphere the spectator gains for the first time a correct conception of the earth's surface and its divisions, accurate with the curvature of the earth—something never before achieved. It is destined to become the object of visits by thousands of school teachers and greater thousands of their pupils, as well as others interested in education or in geography, for it is one of the most interesting maps of the world ever devised.

More than four years were spent in planning and preparing this huge globe, under the direction of Chester Lindsay Churchill of Boston, architect of the Christian Science Building, and it is complete to the last detail, every important island, ocean deep and shoal as well as the continents and oceans, bays, seas, etc., being shown and labelled. The cost was $35,000.

The framework is of bronze, and the map is put together in sections, so that any one can be removed and another put in should there be a change in the world's countries. In all 600 sections were cast in exactly the proper contours and painted in colors by a special sandblast and spray process. The bronze frame comprises the longitudinal and latitudinal lines, set at 10° intervals, with the equator line of bronze at the exact geographical point, and the various international date lines shown. Ranged around the equator at the different time changes are bronze clocks connected with a master clock, which give the time day or night at any point around the world as compared with Boston time. Following the sandblasting and spraying of the colors, the sections were fired in a kiln to make the colors permanent and practically imperishable.

Painted instructions, occupying ocean spaces on the map, tell the story of the mapparium to visitors. One section explains that the map is drawn to a scale of

(Concluded on page 72)

27 Cities Report 1568 Air Conditioning Systems Installed in 1934, 799 in 1933

THE accompanying tables summarize reports received from a number of electric utilities in this country who keep a record of the air conditioning installations added to their lines. For convenience in studying trends and interpreting the data all installations have been reduced to five groups as follows:

Commercial — includes all kinds of stores, restaurants, hotels, beauty parlors, barber shops, offices, including the offices of professional men such as dentists and doctors;

Industrial—includes processing and manufacturing plant installations:

Theatre and Recreational—includes theaters, night clubs, clubs and other establishments designed primarily for amusement, but does not include taverns or broadcasting studios, these latter two being included under Commercial;

Public and Institutional—includes all kinds of federal, state and local government buildings, and hospitals;

Residential—covers homes, both single and multi-family, but does not include residential clubs or hotels. The residential clubs are included under Theatre and Recreational, while the hotels are grouped as Commercial.

It will be noted that Tables 1, 2, 3 and 4 all cover identical cities so that the totals of these tables are believed to be an accurate index of the trend of air conditioning. Some additional reports were received from a few other utilities whose 1933 and prior figures

TABLE 1.—NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN TYPICAL CITIES PRIOR TO 1933
(As reported by 27 utilities to whose lines the installations are connected)

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Boston	8	645	9	250	12	2,745	0	0	8	10	37	3,650
Metropolitan New York:												
Manhattan and Bronx	124	13,183	5	313	42	10,805	0	0	3	7	174	24,308
Brooklyn	8	702	0	0	15	3,738	0	0	0	0	23	4,440
Queens	2	83½	5	1,658	9	2,121¾	0	0	0	0	16	3,863¼
Newark	3	293½	0	0	4	990	0	0	0	0	7	1,283½
Jersey City	1	3	0	0	3	900	0	0	0	0	4	903
Philadelphia	42	5,635	40	2,911	29	4,997	3	203	0	0	114	13,746
Baltimore	18	801	5	412	7	1,643	2	347	3	8	35	3,211
Washington	20	1,464¼	6	125	5	2,032	8	348	9	26½	48	3,995¾
Rochester	2	199	10	22,135	4	1,274	0	0	2	2	18	23,610
Buffalo	0	0	1	40	4	1,000	0	0	0	0	5	1,040
Pittsburgh	10	841	1	493	7	2,377	0	0	0	0	18	3,711
Toledo	2	325	2	205	2	870	0	0	0	0	6	1,400
Detroit	56	6303	1	575	14	3,630	1	60	10	41½	82	10,609½
Cincinnati	27	2298	0	0	6	1,357½	2	6	8	14½	43	3,676
Indianapolis	2	320	0	0	0	0	0	0	0	0	2	320
Metropolitan Chicago:												
Chicago	126	12,431	54	5,183½	61	14,339	3	123	9	14	253	32,090½
Environs	8	222	5	1,750	18	1,576	0	0	7	54½	38	3,602½
Milwaukee	10	780	1	8	8	2,142	0	0	1	3	20	2,933
St. Louis	49	2011	11	938¼	7	3,558	0	0	24	58	91	6,565¼
Minneapolis	11	284	0	0	14	266	0	0	0	0	25	550
St. Paul	4	125	0	0	6	145	1	30	0	0	11	300
Denver	1	6	0	0	3	325	0	0	1	3	5	334
Atlanta	1	651	0	0	4	1,667	0	0	0	0	5	2,318
Birmingham	2	28	0	0	2	570	0	0	2	33½	6	631½
Louisville	1	5	2	295	5	451	0	0	0	0	8	751
New Orleans	12	1,215½	6	109	4	1,442	0	0	3	4½	25	2,771
Dallas	15	2,010¼	0	0	3	758	0	0	3	7½	21	2,775¾
Houston	14	1,157	0	0	6	1,577	0	0	1	1½	21	2,735½
Total	579	54,022	164	37,400¾	304	69,296¼	20	1,117	94	289	1,161	162.125

TABLE 1A—NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN SEVERAL ADDITIONAL CITIES PRIOR TO 1934

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Kansas City	112	1,638½	3	71	12	1,625	4	4½	94	189½	225	3,528½
Omaha	36	363	2	14½	4	1,231	0	0	12	22½	54	1,631
Richmond (Va.)	14	1,250	3	585	5	910	1	5	12	24	35	2,774
Miami	17	344	1	2	3	425	0	0	3	3	24	774
Total	179	3,595½	9	672½	24	4,191	5	9½	121	239	338	8,707½

were not available in the same form as for the 27 utilities, and these are shown in Tables 1A and 3A.

The exceedingly sharp increase in the capacity of Public and Institutional building installations during 1934 was due to the extraordinarily large jobs installed in federal government buildings in Washington. Indications are that a large figure will also be reported from this city for 1935. There was also a large increase in the number of commercial installations which totalled 1000 during 1934.

Examination of the tables indicates that the average job is decreasing in size from year to year. But few

TABLE 2.—NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN TYPICAL CITIES DURING 1933
(As reported by 27 utilities to whose lines the installations are connected)

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Boston	18	427	0	0	3	83	1	1	2	5	24	516
Metropolitan New York:												
Manhattan and Bronx	74	5,162	0	0	4	1,393	0	0	12	36	90	6,591
Brooklyn	7	95	0	0	4	180	0	0	0	0	11	275
Queens	5	18	0	0	0	0	0	0	2	1¾	7	19¾
Newark	8	288½	0	0	0	0	0	0	0	0	8	288½
Jersey City	6	29	0	0	0	0	0	0	1	2	7	31
Philadelphia	25	345	16	623	0	0	5	75	0	0	46	1,043
Baltimore	24	186	4	82	2	103	2	16	5	10	37	397
Washington	29	427	1	3	0	0	10	248	6	15	46	693
Rochester	4	117	0	0	0	0	0	0	0	0	4	117
Buffalo	4	85½	2	15	0	0	0	0	0	0	6	100½
Pittsburgh	15	51	0	0	0	0	0	0	2	6	17	57
Toledo	1	3	0	0	0	0	0	0	0	0	1	3
Detroit	31	226½	1	1	2	40	0	0	7	14	41	281½
Cincinnati	21	173	0	0	3	280	2	20	6	12½	32	485½
Indianapolis	4	49	0	0	0	0	0	0	0	0	4	49
Metropolitan Chicago:												
Chicago	91	1,695	7	583	15	705	2	121½	11	15	126	3119½
Environs	13	124	1	65	6	360	0	0	14	31½	34	580½
Milwaukee	10	142	1	103	0	0	0	0	0	0	11	245
St. Louis	41	677¾	5	144¾	1	20	0	0	34	86½	81	929
Minneapolis	27	71	0	0	7	84	1	10	43	19	78	184
St. Paul	4	16	0	0	0	0	0	0	0	0	4	16
Denver	1	4½	0	0	0	0	0	0	0	0	1	4½
Atlanta	9	32	1	4	0	0	0	0	3	18	13	54
Birmingham	4	160¾	0	0	0	0	0	0	1	1½	5	162¼
Louisville	8	103	2	13½	1	145	0	0	0	0	11	261½
New Orleans	12	1,467	4	4½	0	0	0	0	10	23½	26	1,495
Dallas	9	114½	0	0	0	0	0	0	7	13½	16	127¾
Houston	11	791	0	0	0	0	0	0	1	1½	12	792½
Total	516	13,101	45	1,641¾	48	3,393	23	491½	167	312	799	18,939¼

TABLE 3.—NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN TYPICAL CITIES DURING 1934
(As reported by 27 utilities to whose lines the installations are connected)

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Boston	45	2,748½	0	0	0	0	0	0	4	6½	49	2,755
Metropolitan New York:												
Manhattan and Bronx	165	7,188	7	121	9	291	0	0	14	50	195	7,650
Brooklyn	21	474¼	0	0	8	272	1	¾	0	0	30	747
Queens	1	2¾	4	30	5	155	0	0	6	15½	16	203¼
Newark	7	116	1	2	0	0	0	0	0	0	8	118
Jersey City	4	62	0	0	0	0	0	0	2	2	6	64
Philadelphia	71	1,419¾	14	429	4	143	23	408	37	56	149	2,455¾
Baltimore	52	1,271	0	0	12	612	4	84	6	6	74	1,973
Washington	50	1,577¾	1	28	0	0	23	14,250½	9	12	83	15,868¼
Rochester	8	289	0	0	0	0	1	265	1	1	10	555
Buffalo	9	103	0	0	0	0	1	2½	1	15	11	120½
Pittsburgh	46	412½	1	10	0	0	0	0	11	9½	58	432
Toledo	9	52	0	0	0	0	0	0	8	13	17	65
Detroit	52	635¾	3	71	3	70	1	4	18	24¾	77	805½
Cincinnati	45	1,088	0	0	3	177½	1	19	25	35¼	74	1,319¾
Indianapolis	9	77	2	1¾	0	0	0	0	9	25¼	20	104
Metropolitan Chicago:												
Chicago	155	3,941	19	832½	35	1,988	6	73½	24	43½	239	6,878½
Environs	13	255½	0	0	3	100	0	0	11	21½	27	377
Milwaukee	6	114	3	8	1	21	0	0	9	22	19	165
St. Louis	71	1,008¼	4	108¼	3	101½	2	5¾	70	144	150	1,367¾
Minneapolis	19	177	1	10	3	33	1	19	2	5	26	244
St. Paul	12	48	0	0	4	125	0	0	21	2	37	175
Denver	3	15½	1	10	0	0	0	0	0	0	4	25½
Atlanta	36	424½	0	0	0	0	1	1½	9	15¾	46	441¾
Birmingham	10	85¼	1	2½	0	0	0	0	2	3	13	90¾
Louisville	18	242½	1	13	1	30	0	0	11	33	31	318½
New Orleans	19	462¾	0	0	0	0	3	11½	11	31½	33	505¾
Dallas	20	363¾	0	0	0	0	0	0	15	28¼	35	392
Houston	24	436	0	0	2	176	0	0	5	46½	31	658½
Total	1,000	25,091¼	63	1,675¾	96	4,295	68	15,145	341	667¾	1,568	46,874¼

residential installations are reported relatively since most of the utilities are reporting only summer air conditioning.

Railroad air conditioning has also increased sharply in the last few years. One estimate is that railroad car conditioning amounted to the following dollar volume:

1931	$ 15,000
1932	40,000
1933	2,650,000
1934	21,800,000

TABLE 3A—NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN SEVERAL ADDITIONAL CITIES DURING 1934

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Hartford*	6	523½	1	10	0	0	0	0	0	0	7	533½
Scranton*	4	30	1	17	0	0	0	0	0	0	5	47
Kansas City	70	771½	1	12	0	0	4	4½	62	129½	137	917½
Omaha	23	222	2	14½	1	85	0	0	12	22½	38	344
San Francisco and No. California*	175	206½	6	161¾	21	128½	3	10	4	9	209	515¾
Richmond (Va.)	13	1,200	0	0	1	55	0	0	11	12	25	1,267
Miami	16	294¼	1	2¼	0	0	0	0	3	3¼	20	299¾
Syracuse*	3	32	0	0	0	0	0	0	0	0	3	32
Total	310	3,279¾	12	217½	23	268½	7	14½	92	176¼	444	3,956½

*No figures prior to 1934.

TABLE 4.—TOTAL NUMBER AND SIZE OF SUMMER AIR CONDITIONING INSTALLATIONS IN TYPICAL CITIES AS OF JANUARY 1, 1935
(As reported by 27 utilities to whose lines the installations are connected)

City	Commercial		Industrial		Theatre and Recreational		Public and Institutional		Residential		Total	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Boston	71	3,820½	9	250	15	2,828	1	1	14	21½	110	6,921
Metropolitan New York:												
Manhattan and Bronx	363	25,533	12	434	55	12,489	0	0	29	93	459	38,549
Brooklyn	36	1,271¼	0	0	27	4,190	1	¾	0	0	64	5,462
Queens	8	104¼	9	1,688	14	2,276¾	0	0	8	17¼	39	4,086¼
Newark	18	698	1	2	4	990	0	0	0	0	23	1,690
Jersey City	11	94	0	0	3	900	0	0	3	4	17	998
Philadelphia	138	7,399¾	70	3,963	33	5,140	31	686	37	56	309	17,244¾
Baltimore	94	2,258	9	494	21	2358	8	447	14	24	146	5,581
Washington	99	3,469	8	156	5	2032	41	14,846½	24	53½	177	20,557
Rochester	14	605	10	22,135	4	1,274	1	265	3	3	32	24,282
Buffalo	13	188½	3	55	4	1,000	1	2½	1	15	22	1,261
Pittsburgh	71	1,304½	2	503	7	2,377	0	0	13	15½	93	4,200
Toledo	12	380	2	205	2	870	0	0	8	13	24	1,468
Detroit	139	7,165¼	5	647	19	3,740	2	64	35	80¼	200	11,696½
Cincinnati	93	3,559	0	0	12	1,815	5	45	39	62¼	149	5,481¼
Indianapolis	15	446	2	1¾	0	0	0	0	9	25¼	26	473
Metropolitan Chicago:												
Chicago	372	18,067	80	6,599	111	17,032	11	318	44	72½	618	42,088½
Environs	34	601½	6	1,815	27	2,036	0	0	32	107½	99	4,560
Milwaukee	26	1,036	5	119	9	2,163	0	0	10	25	50	3,343
St. Louis	161	3,697	20	1,191¼	11	3,679½	2	5¾	128	288½	322	8,862
Minneapolis	57	532	1	10	24	383	2	29	45	24	129	978
St. Paul	20	189	0	0	10	270	1	30	21	2	52	491
Denver	5	26	1	10	3	325	0	0	1	3	10	364
Atlanta	46	1,107½	1	4	4	1,667	1	1½	12	33¾	64	2,813¾
Birmingham	16	274	1	2½	2	570	0	0	5	38	24	884½
Louisville	27	350½	5	321½	7	626	0	0	11	33	50	1,331
New Orleans	43	3,145¼	10	113½	4	1,442	3	11½	24	59½	84	4,771¾
Dallas	44	2,488½	0	0	3	758	0	0	25	49	72	3,295½
Houston	49	2,384	0	0	8	1,753	0	0	7	49½	64	4,186½
Total	2,095	92,214¼	272	40,717¾	448	76,984¼	111	16,753½	602	1,268¾	3,528	227,938½

Signals Show Outdoor Weather

ALTHOUGH the occupants of the new windowless office building of the Hershey Chocolate Corp., Hershey, Pa., will be quite unaware of the outdoor weather conditions, they will be informed by an electric signaling system just what to expect when they go out.

A signaling system which is described as the "electric weather man," indicates the weather. A small brass panel is placed near the electric clock which is installed in each office, with three colored glass bull's eyes in the panel and a miniature electric light behind each.

The colors are red, white, and green so that seven different combinations have been adopted to indicate the outside weather. Thus white will indicate clear weather; white and green, cloudy; red, rain; red and green, sleet; green, snow; red and white, clear with temperatures below 10°, and red, white, and green, clear with temperature above 90°.

In this way each employe will be informed of the weather outside whenever he glances at the clock.

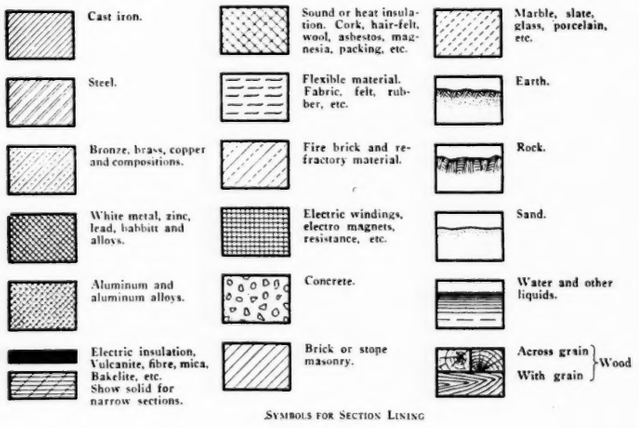
The complete air conditioning system is being installed by the York Ice Machinery Corporation. Its engineers estimate that a saving of 25% in overall operating costs will be effected by dispensing with windows in this building.

Drawings and Drafting Room Practice Standardized

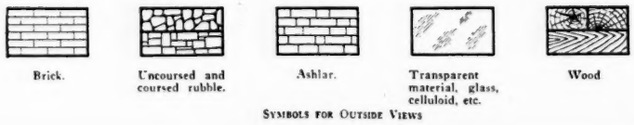
FOR quite some time a need has existed for a national standard for engineering drawings. Certain of the more progressive companies have adopted standards which have worked out very well as long as they were used by persons familiar with the symbols in use. When they were used by outsiders, however, a certain amount of confusion, mistakes and delays were sure to occur.

In December, 1925 the American Standards Association's Standards Council approved the request to organize a national representative committee to develop standards for drawings and drafting room practice. Invitations were sent to forty-seven organizations to appoint representatives to serve on the sectional committee. As a result of a meeting of this committee, six sub-committees were appointed and undertook the formulation of tentative drafts of the several sections of the final report. After the reports were combined into a proposed standard, it was submitted to the sponsor societies for approval and then to the American Standards Association for acceptance as an American Standard. This final acceptance was made in May of this year. Copies of the report are now available and may be obtained from the American Standards Association, 29 W. 39 St., New York, for 50c.

It may be said that in general the standard is not a wide deviation from accepted practice. This can be readily understood when the method of compiling the standard is known. At first questionnaires were sent to a large number of concerns using drawings. Preliminary reports were made and sent out for comment and criticism, then revised and sent out again. After the second series of reports had been returned the final report was prepared embodying what seemed to be the best practice.


Cast iron.
Steel.
Bronze, brass, copper and compositions.
White metal, zinc, lead, babbitt and alloys.
Aluminum and aluminum alloys.
Electric insulation, Vulcanite, fibre, mica, Bakelite, etc. Show solid for narrow sections.
Sound or heat insulation. Cork, hair-felt, wool, asbestos, magnesia, packing, etc.
Flexible material. Fabric, felt, rubber, etc.
Fire brick and refractory material.
Electric windings, electro magnets, resistance, etc.
Concrete.
Brick or stone masonry.
Marble, slate, glass, porcelain, etc.
Earth.
Rock.
Sand.
Water and other liquids.
Across grain
With grain
Wood

SYMBOLS FOR SECTION LINING



SYMBOLS FOR OUTSIDE VIEWS

The items covered in the standard include the arrangement of views, line work, dimension, sheet sizes and lettering. A standard for graphical symbols will be presented for approval and issued as a separate publication.

Lines and Line Work

Regarding the characteristics of lines in drawings the standards call for clean, black lines to permit process reproductions. As few hidden lines as practicable should be shown, sections being preferable in many cases. The actual width of each type of line should be governed by the size and style of the drawing. Three weights of line, heavy, medium and light are considered desirable on finished drawings in ink, although in rapid practice and in particular on penciled drawings from which blueprints are to be made this may be simplified to two weights, medium and light.

Symbols for Selections

Symbolic section lining for the graphic indication of construction may be used when it is desired to call special attention or to identify certain parts. If preferred the section-lining of any piece may be made by equally spaced full lines in one direction. In this an opening is left in the sectioning to provide for a reference letter or word to indicate the material of which the part is made. Even when the symbolic types of section lining are employed it will be found desirable to use reference letters to indicate the heat treatments which the material is to receive. Symbols used for showing materials and outside views are shown in the figure.

Lettering

The most important requirement for lettering as used on working drawings is legibility, the second is ease and rapidity of execution. These two requirements are met in the single stroke commercial gothic letter, now in universal use throughout the technical world. The following practice is recommended in the Standard:

a. That single stroke commercial gothic lettering either vertical or inclined at a slope of 2 in 5 be used on all working drawings for titles, notes, etc.

b. That only capitals be used in the title box.

c. That for notes, bills of material, etc., if the vertical style is chosen the letters should be all caps. If the inclined style is chosen the letters may be all caps or caps and lower-case.

It is not desirable to grade the size of lettering with the size of drawing except when a reduced photographic reproduction of the drawing is to be made. In other words the size and weight of the lettering should be such as will produce legible prints from tracings either in pencil or ink. Approved specimens of vertical and inclined letters are shown.

ESTIMATING THE AMOUNT OF VENTILATION AIR

VOLUME OF VENTILATION AIR FOR VARIOUS TYPES OF BUILDINGS[1]

(As found in various textbooks, reference books, catalogs, and other publications. Total volume (C_r) in cubic feet per hour can be computed from unit figures below, as shown at the top of each column.)

Type of Building	No. of Changes per Hour, (n). $C_r = n \times$ Room Vol.		Cu. Ft. per Occupant per Hour, (A). $C_r = A \times$ No. Occupants		Cu. Ft. per Sq. Ft. Floor Surface per Hour, (B). $C_r = B \times$ No. Sq. Ft.	
	Min.	Max.	Min.	Max.	Min.	Max.
Commercial						
Garages	6	12	—	—	—	—
Offices	1½	12	—	—	—	—
Waiting rooms (public)	4	6	—	—	—	—
Restaurants (dining)	4	20	—	—	—	—
Restaurants (kitchen)	4	60	—	—	240	240
Stores (retail)	6	12	—	—	—	—
Farm Buildings						
Cow	—	—	3000	6000	—	—
Horse	—	—	3600	4200	—	—
Hog	—	—	1200	1500	—	—
Sheep	—	—	600	900	—	—
Hospitals						
Dining rooms	6	12	—	—	90	90
Kitchens	20	60	—	—	240	240
Operating rooms	—	—	3000	3000	—	—
Toilets	7.5	30	—	—	120	120
Wards (ordinary)	—	—	2100	4500	60	60
Wards (contagious)	—	—	2400	6000	—	—
Hotels						
Barber shops	7.5	7.5	—	—	—	—
Cafes	7.5	7.5	—	—	—	—
Dining rooms	4	20	—	—	90	90
Guest rooms	3	5	—	—	—	—
Kitchens	4	60	—	—	240	240
Lobbies	3	4	—	—	—	—
Lounges	6	6	—	—	—	—
Toilets	10	12	—	—	—	—
Industrial						
Bakeries	20	20	—	—	—	—
Factories (general)	1	12	1500	2000	—	—
Factories (unhealthy)	—	—	3500	3500	—	—
Foundries	3	12	—	—	—	—
Laundries	12	30	—	—	—	—
Paint booths	0	600	—	—	—	—
Paint rooms	30	60	—	—	—	—
Textile mills	4	4	—	—	—	—
Prisons						
Single cells	9	12	—	—	—	—
Sleeping cells	6	6	—	—	—	—
General quarters	6	6	1800	1800	—	—
Residences						
Bathrooms and toilets	1	5	—	—	—	—
Halls	1	3	—	—	—	—
Kitchens	1	40	—	—	—	—
Living rooms	1	2	—	—	—	—
Sleeping rooms	0	1	—	—	—	—
Social, Recreational, Public, Educational and Religious						
Assembly rooms, including concert and dance halls, lodge rooms, church and theater auditoriums	4	30	600	4000	90	120
Billiard and bowling	6	20	—	—	—	—
Classrooms (colleges)	—	—	1500	2400	—	—
Classrooms (schools)	—	—	1800	2400	120	120
Corridors	4	4	—	—	30	30
Dining rooms	5	20	—	—	90	90
Gymnasiums	12	12	—	—	90	90
Kitchens	15	60	—	—	120	120
Laboratories	6	20	—	—	—	—
Locker rooms	2	10	—	—	120	120
Projection booths	30	30	—	—	90	90
Reading rooms	3	5	—	—	—	—
Toilets	10	30	—	—	120	120
Engine and Boiler Room	3	12	—	—	—	—

[1]See explanation on other side.

Published by Heating and Ventilating, *148 Lafayette St., New York.*

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ESTIMATING THE AMOUNT OF VENTILATION AIR

In order to arrive at figures showing the heat quantity involved in the ventilation air deliberately passed through a building, use is usually made of the formula:

$$V = \frac{C_v (t_i - t_o)}{55}$$

where V = Heat from Ventilation Air, B.t.u. per hour.
C_v = volume of ventilation air flowing, cubic feet per hour.
t_i = temperature of indoor air, °F.
t_o = temperature of outdoor air, °F.
$1/55 = 0.018$ = heat to raise 1 cu. ft. of air at 70° through 1°.

Values for use in fixing t_i and t_o can be found on HEATING AND VENTILATING's Reference Data Sheets 57-58.

Fixing suitable values for C_v is always troublesome. It is important that they be fixed as definitely as possible for the value enters into the sizing of equipment and greatly affects its cost. There is a variety of procedures used in fixing the quantity. The table on the opposite side of this sheet is only *one* way of doing this.

The table was prepared by carefully reviewing and tabulating values as reported in standard textbooks, handbooks, catalogs, and similar publications. It will be noted that three kinds of figures are given. Those in the first column are in terms of number of air changes per hour, those in the second in cubic feet per hour per occupant, and those in the third in cubic feet per hour per square foot of floor area. The method of arriving at values of C_v is indicated at the top of each column. The three figures are alternates. Select one method to use depending on your judgment of which is most suitable. Then fix the upper and lower limiting values of C_v. Select one in between these limits and use it as C_v in the above formula.

Another point about the figures in the table is the great range covered by many of them. For instance, in the case of paint booths the figures show that from zero to 600 air changes per hour are required. With such a range there must be some additional information before deciding where a particular job falls in between such wide limits. Therefore use the figures with the greatest care and only after careful thought to select one which fits the case. An intelligent selection will necessarily require experience. In other words the table, while it can be made helpful, in no way sets up a specific rule of practice—it merely serves as a guide based on the findings of others. It is thought to be the most complete compilation of ventilation air quantities of this kind put together in a single table.

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MODERNIZING SECTION

Heating Records Aid Economical Operation†

By J. EARL SEITER‡

BUILDING engineers are naturally interested in the large proportion of the building operating cost that is annually charged to the heating system. Therefore, it deserves and should receive a generous part of the engineer's attention and activity in its operation. The tenants of a building, whether it be commercial or residential in character, insist on receiving the proper heating service to which they are entitled and for which they pay. The engineer must keep this in mind, and at the same time must discharge his responsibility to the owner of the building. He is obliged to be constantly aware of all physical conditions pertinent to the operations and to the mechanical equipment with which he operates. He should be so equipped as to have a constant check on both inside and outside temperatures. Recording thermometers are inexpensive and serve an excellent purpose. He should as well be acquainted with the per cent of occupancy of the building, whether or not the radiation in occupied space is for the most part shut off and what the varying requirements of tenants or sections of the building are, so that he may serve the system efficiently and at an economical rate.

†Abstracted from a paper before the National Association of Building Owners and Managers.

‡Assistant Manager, New Business Dept., Consolidated Gas, Electric Light & Power Co., Baltimore, Md.

In the operation of a heating system, actual records of the cost and the factors making up the cost are essential to economical operation. Continual checking and recording of operating data, supplemented by constant endeavor to improve conditions, cannot help but reflect in lowered costs.

Often, however, the heating system, from the standpoint of economy, receives the least attention in its operation. A simple form or log can quickly be devised which, if properly kept, will furnish the engineer and the building manager with an intelligent indication of the operation and costs.

Since there is a direct relation between the steam consumption and the difference in temperature between the inside and outside, it is of importance that a record of these temperatures be maintained.

On a cold day when temperature is at or below that for which the heating system was designed, there should be very little heat wasted in the building, because the building cannot be overheated to any great extent. Now let's do a little figuring—take the steam consumption for that day and divide it by the difference between 65 and the mean outside temperature. This will give you the steam consumption per degree per day under the most favorable conditions for the greatest possible economy in operation. Such units of usage may be considered as 100% heating efficiency.

It will be found that the units of usage for other days will be slightly higher, or in other words, the heating efficiency will be lower. The ratio of the lowest unit usage in the heating season to the daily unit usage will represent the heating efficiency for the various days.

This heating efficiency is comparable with those of other buildings, and offers fair comparisons on several buildings in the operation, and at the same time overcomes the objections to comparisons that are based on rentable area, radiation, volume, and so forth.

Other factors such as wind, humidity, solar radiation, shadows, and the like have distinct bearing on the heating requirements for any specific day's study. While no general method of computing these effects has been accepted, usually the building engineer through experiment and experience will quickly determine the effects and be guided accordingly.

RECORD OF HEATING

Building ---------- Degree Days, Base 65° ----------

Month ---------- Meter Constant ----------

Date	Mean Temp. From Weather Bureau	Degree Days 65° Minus (2)	Meter Reading From Meter	Steam Consumption Meter Constant Times Difference	Lb. of Steam per Degree Day (5) Divided by (3)	Weather Conditions
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1						
2						
3						
4						
27						
28						
29						
30						
31						
Month						

Lowest Previous Record _____
Previous Year _____
Previous Month _____

Heating Efficiency = Lowest Previous Record (Item 6) / Record This Month (Item 6) =

Reducing Operating Costs by Changes in Mechanical Equipment

By G. KENDRICK BRINGHURST†

This is the third article of a series by Mr. Bringhurst covering case histories of buildings in which modernizing has been carried through with a resulting profit to the owners

IN order to retain tenants, the owners of a four-story twin building found it necessary to correct heating troubles, operating savings being of secondary consideration in this case. However, the replacement of worn-out equipment reduced the cost of heating about 47%.

Two brick-set, low pressure steam boilers, 30 years in use, of obsolete pattern, with leaking settings and burned-out grate bars and supports, had to be replaced. Typical of other properties, the chimney was seldom cleaned or its brickwork repaired. As no clean-outs were provided, the janitors allowed dirt to accumulate in the chimney rather than take down the breeching each spring. There being no outside air supply to the five indirect benches which supplied warm air heat to 40% of the heated area, coal gas and smoke frequently leaked from the boiler settings and breeching into the basement and up the warm air flues. This condition also constituted a fire hazard. In severe weather, 12 to 15 lb. steam pressure was carried and the building could not be satisfactorily heated.

The new work included a jacketed cast iron boiler, water feeder, new breeching, cleaning of chimney (from the base of which several cans of dirt were removed), chimney cracks plastered tight, one of the basement indirect radiators removed and direct cast iron radiators placed in the rooms formerly served by this stack, thereby reducing the equivalent radiator load, a larger basement supply main provided, piping leaks and room warm air registers repaired, and new air vent valves provided throughout, all at a cost of $1135. The low bid to replace the four remaining indirect benches with direct cast iron room radiators was $540, but as these were for rooms then vacant, this work was deferred.

During the preceding season of 4170 degree-days, with 2880 sq. ft. of radiator in use, 88 tons of pea coal, costing $792, were burned at the rate of 14.65 lb. coal per degree-day per 1000 sq. ft. For the season following the changes, 5000 degree days, with 3600 sq. ft. of radiator in use (due to increased rentals), the coal consumption of 98 tons of buckwheat cost $626. Had pea coal been used during this season at the same rate as before the changes, the cost would have been $1188. The estimated saving in coal alone for the year following the changes was therefore about $562, and the return on investment, with allowance for engineering fee, interest and depreciation, was better than 33%.

This case illustrates the importance of ample draft and grate area.

Water Heater Investment Yields 55% Return

In a four-story apartment house, two apartments per floor, stove coal was burned in the cast iron boiler for vapor heating, and no. 2 fuel oil was burned in a small tank heater for domestic hot water. The yearly costs were:

Heating—34 tons stove coal @ $10.50	$357
Hot water—1500 gal. no. 2 oil @ 7c	105
Burner electricity, estimated	22
Burner servicing	25
Total	$509

This was at the rate of $64 per apartment per year, much too high for the requirements.

The small tank heater and combustion chamber brickwork were in bad shape, and the oil burner was of obsolete design in constant need of attention and servicing.

As the heating boiler had excess capacity, being 50% oversize for the heating load, an indirect coil water heater was connected below the boiler water line to provide domestic hot water during the eight months heating season, and the tank heater and oil burner were removed. For summer hot water, a new coal fired tank heater was provided, cross connected and valved with the indirect heater. The total cost of these changes was $198.

The chimney being 48 ft. high, and the steam boiler having excess grate area, pea coal was substituted for stove coal, and burned satisfactorily with natural draft.

The yearly cost of heating and hot water after the changes was: 43 tons pea coal, $376 ($47 per apartment), a reduction of 26%; return on investment, including interest and depreciation, 55%.

Oil Burner Cuts Apartment Costs

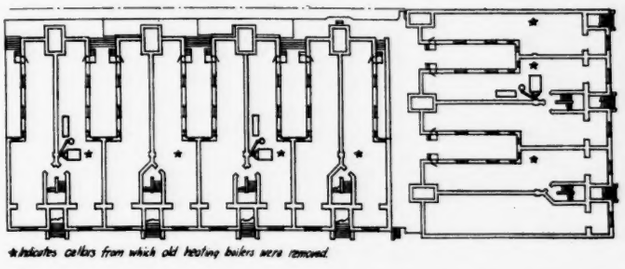
In a three-story apartment building, $341 was saved due to the installation of a more modern oil burner. This building, with a drugstore on the ground floor and two large apartments on each of the two upper floors, was heated by hot water, the total boiler load being 1700 sq. ft. During a 4500 degree-day season, 11,200 gal. of no. 2 oil cost $616.

At a cost of $475, the old oil burner was replaced with a modern full-automatic unit using no. 4 oil. Following the change, based on a comparable season, the oil used was reduced to 6100 gal., costing $275.

†Consulting Engineer, Philadelphia.

The saving of $341 made the investment return 70%.

Had rice coal been used, the cost of a blower installation would have been about $120, and the estimated fuel saving about $450, a much better proposition. However, as no janitor was employed at this property, full-automatic oil burning was the most satisfactory means of heating.



Plan of basement of apartment where three magazine boilers replaced seven old boilers

sumption for both heating and hot water was reduced to 240 tons per year. Buckwheat costing $6.75, the cost of coal became $1620. The saving in coal alone was therefore $2900, and the janitor's helper was no longer needed. The cost per apartment for heating and hot water was reduced from $115 to $42 as a result of the changes.

Magazine Boilers Save 63%

Replacing worn-out boilers in a group of apartments reduced the cost of coal 65%. The group consisted of 13 three-story units, three apartments per unit, a total of 39 apartments, heated with one-pipe steam.

Each alternate cellar had a cast iron heating boiler and a tank heater, there being seven of each, burning chestnut size coal. The total heating load was about 8300 sq. ft., and the average coal consumption for both heating and hot water, 320 tons, cost $4500.

During severe weather, the janitor was kept busy tending the 14 fires, and when, due to their age, the boilers became so worn out as to require additional attention, it was necessary to provide the janitor with a helper. The owner then planned to install new boilers and asked for a specification to cover this replacement.

It was obvious that a fewer number of boilers would burn less coal and require less attention. As there was neither the space nor headroom available for one central boiler plant, three new boilers were provided, two of these to supply 12 apartments per boiler and the third for the remaining 15 apartments. Each new boiler was steel, magazine feed, equipped with below-the-water-line indirect coil heaters. Three new tank heaters and storage tanks were also provided, the tank heaters being cross connected with the indirect coil water heaters.

Following the changes, which cost $7880, coal con-

Change from Gas to Oil Pays in One Season

Gas to heat a three-story suburban residence having 1002 sq. ft. of connected hot water radiators cost $538 during a 4800 degree-day season. The tenant occupying the property refused to remain for another winter unless the owners either paid a good proportion of this gas bill or made some change in the plant whereby the cost would be substantially reduced.

To replace the gas-fired boiler with a new cast iron water boiler, oil fired for full automatic operation, called for an outlay of about $650. However, the gas boiler, with copper tubes and set 12 in. above the floor, being in good condition, it was decided to retain this unit and install an oil burner. In order to obtain the necessary combustion space, a 24-inch pit was dug under the boiler, and a pressure type oil burner with full automatic controls with a 275-gal. oil storage tank was provided at a total cost of $345.

During the first season in operation, the oil used during 4800 degree-days was 2780 gal. and cost $171. As the total boiler load, including line losses, was about 1200 sq. ft., the oil consumption was at the rate of about 2 1/3 gal. per sq. ft. equivalent radiator, very economical operation. The house was occupied by three adults and four children and had to be well heated at all times.

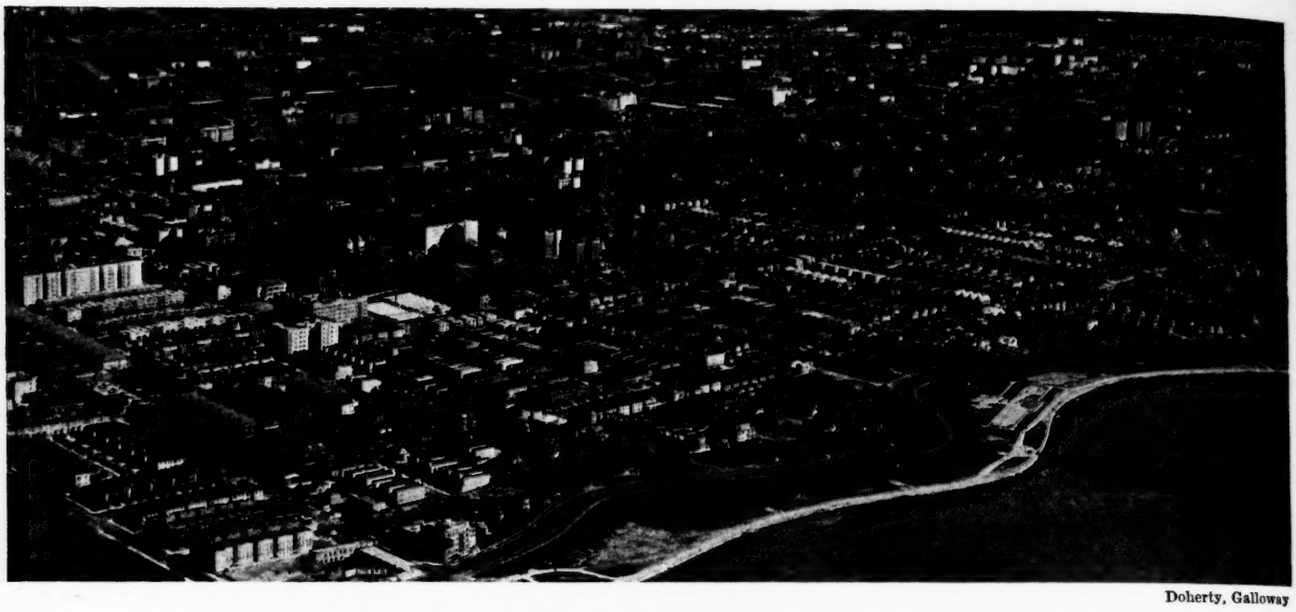
The saving in cost of fuel was therefore $367, and if burner electricity was included, this changeover from gas to oil paid for itself in the first season.

Air Conditioning Increases Restaurant Profits

IN building modernization and in new structures, air conditioning is no longer considered an expensive luxury but rather a profitable and often necessary addition. In hundreds of installations, large and small, it has been demonstrated that air conditioning pays.

A report issued by S. F. Myers, manager air conditioning sales, Westinghouse Electric & Mfg. Company, showed that air conditioning has increased the business of the Waffle Shop, Memphis, Tenn., about 50%. Before air conditioning, they served 350 meals a day at an average check of 32 cents. Now they serve 450 meals at an average of 38 cents. Steak business doubled in midsummer after the installation. The condensing unit and air conditioning units are both in the kitchen.

To increase hot weather business, the Jolly Cafe, Topeka, Kan., was air conditioned in 1934. This installation has been quite successful, increasing business 75%. The complete installation cost approximately $2800, and the operating cost is about $2 per day. It is in use about 100 days a year, 7 hr. a day.



Doherty, Galloway

Detailed Data on Urban Home Heating Systems

broken down both by type of heating and by type of residential building. Figures are based on the Real Property Inventory.

In a previous issue of HEATING AND VENTILATING[1] a table was presented showing the distribution of different types of heating systems in urban residential buildings throughout the United States. These tables consisted of estimates for each state based on returns from the Real Property Inventory conducted by the Department of Commerce in 63 cities. Recent detailed data from the Department now makes it possible to break down these figures not only by the type of heating system but by type of residential building. These have been classified as single-family houses, two-family houses, apartments (including all multifamily dwellings of three or more families), and other residential buildings (including clubs and hotels).

Table 1 shows the number of warm air heating systems by states in these different type residential buildings. Table 2 shows similar information for buildings heated by steam or vapor, Table 3 is devoted to hot water heated buildings, and Table 4 covers buildings heated either by stoves or with no heat.

In using the tables it should be emphasized that the figures apply only to urban residential buildings (urban is defined as a community of over 2500 population) and the tables do not include data on the city of New York, inasmuch as it was felt that it would be inaccurate to extend data from smaller communities to cover a city in which the ratio of apartments to single-family houses is so extraordinarily high.

The first column of figures in Table 1 lists, therefore, the total number of warm air installations *in urban residential buildings*. The second, third, fourth, and fifth columns of figures break the first column down into the four types and these columns thus total to the figure given in the first column. The last column is the per cent of all urban residential structures in a given state which are heated by warm air. Other tables are similarly arranged and the total of the last column

(Text continued on page 72)

[1] "53.8% of Urban Residential Structures Have Central Heating," page 38, November, 1934.

TABLE A.—DISTRIBUTION OF HEATING SYSTEMS IN DIFFERENT TYPE URBAN RESIDENTIAL BUILDINGS
(U. S. totals, not including the city of New York)

	No. with Warm Air	No. with Steam or Vapor	No. with Hot Water	No. with Stove Heat or No Heat	Total No.*	Total %*
Single-family houses	4,814,561	771,694	733,689	5,451,530	11,771,474	75.0
Two-family houses	1,076,778	215,634	159,000	995,026	2,446,438	15.6
Apartments	21,895	85,330	14,069	61,177	182,471	1.2
Other residential	257,567	177,259	95,165	739,249	1,269,240	8.2
Total No.	6,170,801	1,249,917	1,001,923	7,246,982	15,669,623	—
Total, %	39.4	8.0	6.4	46.2	—	100.0

*Since these totals do not include the city of New York, figures given elsewhere must be added to these to obtain U. S. totals of different type buildings.

TABLE 1—NUMBER OF WARM AIR HEATING SYSTEMS IN DIFFERENT TYPE URBAN RESIDENTIAL BUILDINGS
(Based on the Real Property Inventory)

STATE AND REGION	TOTAL NUMBER WARM AIR INSTALLATIONS	NUMBER IN SINGLE-FAMILY HOUSES	NUMBER IN TWO-FAMILY HOUSES	NUMBER IN APARTMENTS	NUMBER IN OTHER RESIDENTIAL BUILDINGS	PER CENT OF STRUCTURES HEATED BY WARM AIR
Maine	11,906	8,334	2,322	48	1,202	15.2
New Hampshire	16,865	11,806	3,289	67	1,703	25.0
Vermont	11,641	8,149	2,270	47	1,175	39.0
Massachusetts	144,111	100,878	28,102	576	14,555	15.7
Rhode Island	20,049	14,034	3,909	80	2,026	13.2
Connecticut	62,714	43,899	12,228	251	6,336	23.0
NEW ENGLAND	267,286	187,100	52,120	1,069	26,997	17.6
New York†	673,153	471,207	163,576	2,019	36,351	73.1
New Jersey	299,466	209,626	72,770	898	16,172	36.9
Pennsylvania	854,715	598,301	207,696	2,565	46,153	55.6
MIDDLE ATLANTIC†	1,827,334	1,279,134	444,042	5,482	98,676	55.8
Ohio	622,009	480,813	115,072	2,488	23,636	53.6
Indiana	252,631	195,284	46,737	1,011	9,599	53.6
Illinois	933,721	721,766	172,738	3,735	35,482	65.4
Michigan	612,984	473,837	113,402	2,452	23,293	76.6
Wisconsin	259,801	200,826	48,063	1,039	9,873	66.5
EAST NORTH CENTRAL	2,681,146	2,072,526	496,012	10,725	101,883	63.9
Minnesota	117,247	106,929	7,504	352	2,462	38.1
Iowa	174,203	158,873	11,149	523	3,658	66.4
Missouri	169,752	154,814	10,864	509	3,565	34.5
North Dakota	14,520	13,242	929	44	305	56.0
South Dakota	22,992	20,969	1,472	69	482	70.2
Nebraska	87,433	79,739	5,596	262	1,836	69.5
Kansas	82,064	74,842	5,252	246	1,724	41.3
WEST NORTH CENTRAL	668,211	609,408	42,766	2,005	14,032	46.2
Delaware	8,969	7,444	1,139	18	368	29 9
Maryland	55,246	45,855	7,016	110	2,265	23 4
District of Columbia	29,380	24,385	3,731	59	1,205	23 4
Virginia	7,864	6,527	999	16	322	4.2
West Virginia	41,105	34,118	5,220	82	1,685	35.2
North Carolina	24,540	20,368	3,117	49	1,006	13.6
South Carolina	5,317	4,413	675	11	218	6.0
Georgia	42,132	34,970	5,351	84	1,727	18.8
Florida	3,034	2,519	385	6	124	1.5
SOUTH ATLANTIC	217,587	180,599	27,633	435	8,920	15.6
Kentucky	18,672	17,402	840	75	355	9.0
Tennessee	32,433	30,228	1,459	130	616	14.4
Alabama	19,908	18,554	896	80	378	10.9
Mississippi	1,221	929	55	5	232	1.4
EAST SOUTH CENTRAL	72,234	67,113	3,250	290	1,581	10.4
Arkansas	297	284	8	2	3	0.3
Louisiana	408	390	11	3	4	0.2
Oklahoma	11,696	11,182	327	70	117	5.5
Texas	8,421	8,850	236	51	84	1.4
WEST SOUTH CENTRAL	20,822	19,906	582	126	208	1.9
Montana	6,985	6,517	307	35	126	14.9
Idaho	8,839	8,247	389	44	159	26.7
Wyoming	4,481	4,180	197	23	81	24.0
Colorado	46,783	43,649	2,058	234	842	33.1
New Mexico	4,424	4,127	195	22	80	16.8
Arizona	2,433	2,270	107	12	44	6.4
Utah	21,691	20,239	954	108	390	33.9
Nevada	3,044	2,840	134	15	55	31.4
MOUNTAIN	98,680	92,069	4,341	493	1,777	26.1
Washington	112,691	108,859	2,141	451	1,240	46.0
Oregon	79,955	77,236	1,519	320	880	57.3
California	124,855	120,611	2,372	499	1,373	10.3
PACIFIC	317,501	306,706	6,032	1,270	3,493	19.9
TOTAL U. S.†	6,170,801	4,814,561	1,076,778	21,895	257,567	39.4

†Not including the City of New York

TABLE 2—NUMBER OF STEAM AND VAPOR HEATING SYSTEMS IN DIFFERENT TYPE URBAN RESIDENTIAL BUILDINGS

(Based on the Real Property Inventory)

STATE AND REGION	TOTAL NUMBER STEAM AND VAPOR INSTALLATIONS	NUMBER IN SINGLE-FAMILY HOUSES	NUMBER IN TWO-FAMILY HOUSES	NUMBER IN APARTMENTS	NUMBER IN OTHER RESIDENTIAL BUILDINGS	PER CENT OF STRUCTURES HEATED BY STEAM AND VAPOR
MAINE	33,994	21,246	7,003	646	5,099	43.4
NEW HAMPSHIRE	18,214	11,384	3,752	346	2,732	27.0
VERMONT	2,657	1,661	547	50	399	8.9
MASSACHUSETTS	400,205	250,128	82,442	7,604	60,031	43.6
RHODE ISLAND	68,350	42,718	14,080	1,299	10,253	45.0
CONNECTICUT	15,815	9,884	3,258	301	2,372	5.8
NEW ENGLAND	539,235	337,021	111,082	10,246	80,886	35.5
NEW YORK†	69,065	34,878	16,852	5,042	12,293	7.5
NEW JERSEY	120,110	60,656	29,307	8,768	21,379	14 8
PENNSYLVANIA	81,475	41,145	19,880	5,948	14,502	5 3
MIDDLE ATLANTIC†	270,650	136,679	66,039	19,758	48,174	8.3
OHIO	48,740	32,071	4,289	6,190	6,190	4.2
INDIANA	16,025	10,545	1,410	2,035	2,035	3.4
ILLINOIS	31,410	20,668	2,764	3,989	3,989	2.2
MICHIGAN	67,220	44,231	5,915	8,537	8,537	8.4
WISCONSIN	9,376	6,169	825	1,191	1,191	2.4
EAST NORTH CENTRAL	172,771	113,684	15,203	21,942	21,942	4.2
MINNESOTA	7,386	3,125	709	2,075	1,477	2.4
IOWA	6,297	2,664	605	1,769	1 259	2.4
MISSOURI	6,396	2,706	614	1,797	1,279	1 3
NORTH DAKOTA	934	395	90	262	187	3 6
SOUTH DAKOTA	884	374	85	248	177	2.7
NEBRASKA	3,019	1,277	290	848	604	2.4
KANSAS	3,775	1,597	362	1,061	755	1.9
WEST NORTH CENTRAL	28,691	12,138	2,755	8,060	5,738	2.0
DELAWARE	1,020	741	104	84	91	3.4
MARYLAND	70,829	51,492	7,225	5,808	6,304	30.0
DISTRICT OF COLUMBIA	37,666	27,473	3 842	3,089	3,262	30.0
VIRGINIA	5,055	3,674	516	415	450	2.7
WEST VIRGINIA	14,247	10,358	1,453	1,168	1,268	12 2
NORTH CAROLINA	24,179	17,578	2.466	1,983	2,152	13 4
SOUTH CAROLINA	1418	1,031	145	116	126	1.6
GEORGIA	12,774	9,287	1,303	1,047	1,137	5.7
FLORIDA	3,843	2,794	392	315	342	1.9
SOUTH ATLANTIC	171,031	124,428	17,446	14,025	15,132	12.4
KENTUCKY	5,602	4,493	258	431	420	2.7
TENNESSEE	10,361	8,309	477	798	777	4.6
ALABAMA	5.296	4,247	244	408	397	2.9
MISSISSIPPI	610	489	28	47	46	0.7
EAST SOUTH CENTRAL	21,869	17,538	1,007	1,684	1,640	3.2
ARKANSAS	694	559	30	83	22	0.7
LOUISIANA	204	164	9	24	7	0.1
OKLAHOMA	1,702	1,372	73	203	54	0.8
TEXAS	4,812	3,878	207	573	154	0.8
WEST SOUTH CENTRAL	7,412	5,973	319	883	237	0.7
MONTANA	891	553	53	170	115	1.9
IDAHO	331	205	20	63	43	1.0
WYOMING	560	348	33	107	72	3.0
COLORADO	3,957	2,458	233	756	510	2.8
NEW MEXICO	2,027	1,259	120	387	261	7.7
ARIZONA	532	330	31	102	69	1.4
UTAH	1,472	914	87	281	190	2.3
NEVADA	553	343	33	106	71	5.7
MOUNTAIN	10,323	6,410	610	1,972	1,331	2.7
WASHINGTON	3,185	2,032	134	771	248	1.3
OREGON	2,930	1,869	123	709	229	2.1
CALIFORNIA	21,820	13,922	916	5,280	1,702	1.8
PACIFIC	27.935	17,823	1,173	6,760	2,179	1.8
TOTAL U. S.†	1,249,917	771,694	215,634	85,330	177,259	8.0

†Not including the City of New York

TABLE 3—NUMBER OF HOT WATER HEATING SYSTEMS IN DIFFERENT TYPE URBAN RESIDENTIAL BUILDINGS

(Based on the Real Property Inventory)

STATE AND REGION	TOTAL NUMBER HOT WATER INSTALLATIONS	NUMBER IN SINGLE-FAMILY HOUSES	NUMBER IN TWO-FAMILY HOUSES	NUMBER IN APARTMENTS	NUMBER IN OTHER RESIDENTIAL BUILDINGS	PER CENT OF STRUCTURES HEATED BY HOT WATER
Maine	10,104	6,982	1,657	101	1,364	12.9
New Hampshire	1,956	1,351	321	20	264	2.9
Vermont	4,687	3,238	769	47	633	15.7
Massachusetts	24,783	17,125	4,064	248	3,364	2.7
Rhode Island	1,671	1,154	274	17	226	1.1
Connecticut	75,530	52,191	12,387	755	10,197	27.7
NEW ENGLAND	118,731	82,041	19,472	1,188	16,030	7.9
New York†	24,863	16,906	4,973	249	2,735	2.7
New Jersey	211,005	143,483	42,201	2,110	23,211	26 0
Pennsylvania	146,040	99,308	29,208	1,460	16,064	9.5
MIDDLE ATLANTIC†	381,908	259,697	76,382	3,819	42,010	11.7
Ohio	47,579	37,825	5,091	666	3,997	4.1
Indiana	9,427	7,494	1,009	132	792	2.0
Illinois	67,102	53,346	7,180	939	5,637	4.7
Michigan	13,603	10,814	1,456	190	1,143	1.7
Wisconsin	46,491	36,960	4,975	651	3,905	11.9
EAST NORTH CENTRAL	184,202	146,439	19,711	2,578	15,474	4.4
Minnesota	106,168	82,387	16,456	1,380	5,945	34.5
Iowa	8,658	6,718	1,342	113	485	3.3
Missouri	15,253	11,837	2,364	198	854	3 1
North Dakota	6.327	4,910	981	82	354	24.4
South Dakota	1,507	1.169	234	20	84	4.6
Nebraska	6,290	4,781	1,075	82	352	5.0
Kansas	3,775	2,930	585	49	211	1.9
WEST NORTH CENTRAL	147,978	114,732	23,037	1,924	8,285	10.2
Delaware	8,639	6,367	1,330	130	812	28.8
Maryland	23,137	17,052	3,563	347	2,175	9.8
District of Columbia	12,304	9,067	1,895	185	1,157	9.8
Virginia	47,934	35,327	7,382	719	4,506	25.6
West Virginia	10,393	7.659	1,601	156	977	8.9
North Carolina	9,203	6,783	1,417	138	865	5.1
South Carolina	2,659	1,960	409	40	250	3.0
Georgia	1,344	991	207	20	126	0.6
Florida	2,427	1,789	374	36	228	1.2
SOUTH ATLANTIC	118,040	86,995	18,178	1,771	11,096	8.5
Kentucky	4,150	3,876	145	21	108	2.0
Tennessee	2,027	1,893	71	10	53	0.9
Alabama	3,287	3,071	115	16	85	1.8
Mississippi	262	245	9	1	7	0.3
EAST SOUTH CENTRAL	9,726	9,085	340	48	253	1.4
Arkansas	298	268	18	5	7	0.3
Louisiana	4,293	3,867	258	69	99	2.1
Oklahoma	425	382	26	7	10	0.2
Texas	601	541	36	10	14	0.1
WEST SOUTH CENTRAL	5,617	5,058	338	91	130	0.5
Montana	3,329	2,822	200	117	190	7.1
Idaho	2,549	2,162	153	89	145	7.7
Wyoming	1.363	1,155	82	48	78	7.3
Colorado	2,827	2,397	170	99	161	2.0
New Mexico	816	691	49	29	47	3.1
Arizona	418	354	25	15	24	1.1
Utah	2,559	2,169	154	90	146	4.0
Nevada	359	304	22	13	20	3.7
MOUNTAIN	14,220	12,054	855	500	811	3.8
Washington	14,699	12,024	470	1,470	735	6.0
Oregon	1,953	1,598	62	195	98	1.4
California	4,849	3,966	155	485	243	0.4
PACIFIC	21,501	17,588	687	2,150	1,076	1.3
TOTAL U. S.†	1,001,923	733,689	159,000	14,069	95,165	6.4

†Not including the City of New York

TABLE 4—NUMBER OF URBAN RESIDENTIAL STRUCTURES WITH STOVE HEAT OR NO HEATING

(Based on the Real Property Inventory)

STATE AND REGION	TOTAL NUMBER STRUCTURES, STOVE OR NO CENTRAL HEATING	NUMBER IN SINGLE-FAMILY HOUSES	NUMBER IN TWO-FAMILY HOUSES	NUMBER IN APARTMENTS	NUMBER IN OTHER RESIDENTIAL BUILDINGS	PER CENT OF STRUCTURES HEATED BY STOVES OR WITH NO HEAT
Maine	22,323	8,639	6,474	826	6,384	28.5
New Hampshire	30,425	11,775	8,823	1,126	8,701	45.1
Vermont	10,865	4,205	3,151	402	3,107	36.4
Massachusetts	348,803	134,987	101,152	12,906	99,758	38.0
Rhode Island	61,818	23,924	17,927	2,287	17,680	40.7
Connecticut	118,612	45,903	34,397	4,389	33,923	43.5
NEW ENGLAND	592,846	229,433	171,924	21,936	169,553	39.0
New York†	153,785	89,042	35,524	1,076	28,143	16.7
New Jersey	180,977	104,785	41,806	1,267	33,119	22.3
Pennsylvania	455,028	263,462	105,111	3,185	83,270	29.6
MIDDLE ATLANTIC†	789,790	457,289	182,441	5,528	144,532	24.2
Ohio	442,136	294,463	79,584	3,537	64,552	38.1
Indiana	193,244	128,700	34,784	1,546	28,214	41.0
Illinois	395,475	263,386	71,186	3,164	57,739	27.7
Michigan	106,432	70,884	19,158	851	15,539	13.3
Wisconsin	75,010	49,957	13,502	600	10,951	19.2
EAST NORTH CENTRAL	1,212,297	807,390	218,214	9,698	176,995	28.4
Minnesota	76,933	62,777	8,232	385	5,539	25.0
Iowa	73,197	59,729	7,832	366	5,270	27.9
Missouri	300,633	245,316	32,168	1,503	21,646	61.1
North Dakota	4,149	3,385	444	21	299	16.0
South Dakota	7,369	6,013	788	37	531	22.5
Nebraska	29,060	23,714	3,109	145	2,092	23.1
Kansas	109,088	89,017	11,672	545	7,854	54.9
WEST NORTH CENTRAL	600,429	489,951	64,245	3,002	43,231	41.6
Delaware	11,369	8,730	1,728	34	877	37.9
Maryland	86,883	66,639	13,206	261	6,777	36.8
District of Columbia	46,204	35,438	7,023	139	3,604	36.8
Virginia	126,388	96,940	19,211	379	9,858	67.5
West Virginia	51,031	39,141	7,757	153	3,980	43.7
North Carolina	122,521	93,973	18,623	368	9,557	67.9
South Carolina	79,230	60,769	12,043	238	6,180	89.4
Georgia	167,854	128,743	25,514	504	13,093	74.9
Florida	192,945	147,988	29,328	579	15,050	95.4
SOUTH ATLANTIC	884,425	678,361	134,433	2,655	68,976	63.5
Kentucky	179,047	151,116	23,634	179	4,118	86.3
Tennessee	180,412	152,269	23,814	180	4,149	80.1
Alabama	154,145	130,099	20,347	154	3,545	84.4
Mississippi	85,137	71,856	11,238	85	1,958	97.6
EAST SOUTH CENTRAL	598,941	505,340	79,033	598	13,770	85.0
Arkansas	97,882	85,941	7,439	489	4,013	98.7
Louisiana	199,531	175,188	15,164	998	8,181	97.6
Oklahoma	198,804	174,550	15,109	994	8,151	93.5
Texas	587,661	515,967	44,662	2,938	24,094	97.7
WEST SOUTH CENTRAL	1,083,878	951,646	82,374	5,419	44,439	96.9
Montana	35,676	30,860	2,533	178	2,105	76.1
Idaho	21,386	18,499	1,518	107	1,262	64.6
Wyoming	12,268	10,612	871	61	724	65.7
Colorado	87,771	75,922	6,232	439	5,178	62.1
New Mexico	19,063	16,490	1,353	95	1,125	72.4
Arizona	34,640	29,964	2,459	173	2,044	91.1
Utah	38,264	33,098	2,717	191	2,258	59.8
Nevada	5,738	4,963	407	29	339	59.2
MOUNTAIN	254,806	220,408	18,090	1,273	15,035	67.4
Washington	114,405	103,421	4,119	1,030	5,835	46.7
Oregon	54,699	49,448	1,969	492	2,790	39.2
California	1,060,666	958,843	38,184	9,546	54,093	87.5
PACIFIC	1,229,770	1,111,712	44,272	11,068	62,718	77.0
TOTAL U. S.†	7,246,982	5,451,530	995,026	61,177	739,249	46.2

†Not including the City of New York

Automatic Control of Effective Temperature in an Office Building

Oklahoma Gas and Electric Building, Oklahoma City, Okla.

By J. E. HAINES†

THE Oklahoma Gas and Electric Co., Oklahoma City, has played a very important part in the advancement of air conditioning in the southwestern section of the country during the past two years. Many air conditioning installations have been made as a result of the interest which this company has created and a general improvement in air conditioning in terms of human comfort and economy of operation has been the result of the engineering assistance which this company has provided.

It was only natural, therefore, that this company would wish to design and install in its own building an air conditioning system incorporating the latest ideas. This system was designed in the spring of 1934 and the installation was put into operation during the early part of the following July. The results obtained were satisfactory from the beginning and the operation of the entire system through the first year has been a tribute to practical and progressive engineering.

The first and fifth floors are now conditioned and plans have been tentatively made for additional systems on the remaining floors. A model bungalow in the basement was conditioned previous to this more recent installation which was completed last summer.

Four unit conditioners were installed on the first floor in convenient locations which deliver conditioned air to the large public lobby at the front of the floor and the accounting and collection departments at the rear of the floor. Three units delivering conditioned air to the general offices of the company were installed on the fifth floor in a central fan room.

Each of these units is of the horizontal overhead type and includes filters, finned type copper coils for cooling or heating, humidity sprays, and belt-driven duplex fan units. One of the units on the first floor discharges directly into the conditioned space and the other three are equipped with short duct systems. The three units on the fifth floor have extensive distributing duct systems and common return, outdoor intake, and exhaust ductwork.

During the summer, chilled water is pumped through the cooling coils and during winter hot water is pumped through the same coils. Refrigeration is provided by two 28.2-ton capacity compressors. Cooling water is refrigerated in a shell and tube cooling tank and stored in two chilled water tanks. The total capacity of the four first-floor units is 13,000 c.f.m., and the total capacity of the three fifth-floor units is 12,000 c.f.m. The entire air conditioning, refrigerating, and heating systems are under automatic control.

At the time that the air conditioning system was be-

†Engineer, Minneapolis-Honeywell Regulator Company.

Character of the main floor made running of ductwork highly undesirable and four unit conditioners were installed.

ing designed it was realized by the Oklahoma Gas and Electric Company engineers that human comfort is dependent upon combinations of dry bulb temperature, relative humidity, and air movement, and that after the air movement has been fixed, comfort is dependent only on combinations of dry bulb temperature and relative humidity which taken as a whole is measured as effective temperature. It was further realized that human comfort and, therefore, effective temperatures are not based upon fixed dewpoints, wet bulb temperatures, dry bulb temperatures, or relative humidities, and that if these factors were permitted to vary between reasonable limits, comfort conditions could be maintained with maximum operating economy.

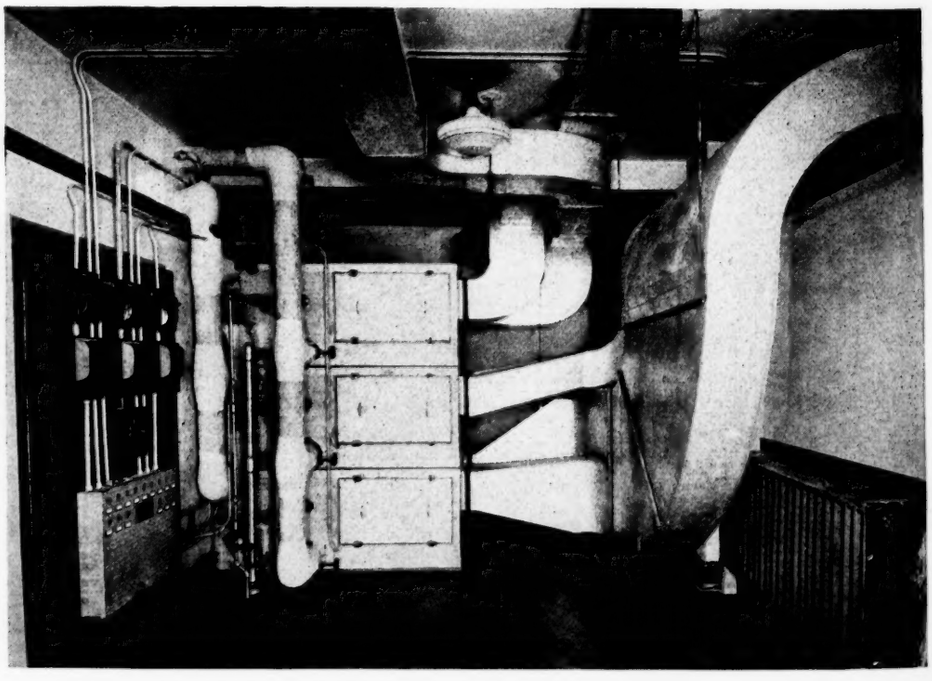
In addition it was felt desirable to raise the inside index of comfort conditions with a rise in outdoor temperatures because of the difference in the wearing apparel of employes and customers, and to avoid as much as possible the unpleasant sensations of chill or intense heat by those entering or leaving the building during hot weather.

An automatic control system was therefore installed which in summer produces compensated effective temperature control. In this method the outdoor air temperature is measured and thereby automatically determines the inside effective temperature control point according to a predetermined schedule. The inside relative humidity is then measured and automatically determines the inside dry bulb temperature control point which will produce the effective temperature which has been previously determined. The inside dry bulb temperature is then controlled at this point.

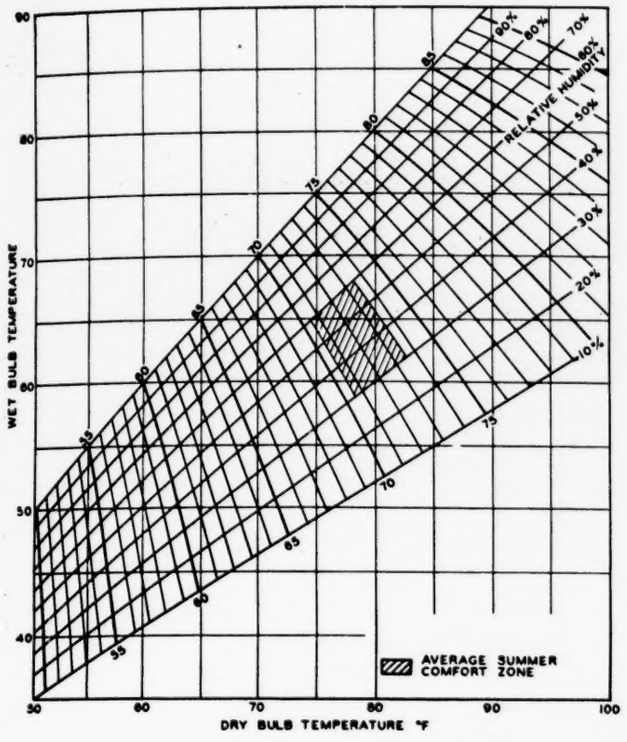
Control is accomplished by the use of an outdoor temperature compensator, an inside relative humidity compensator, and a thermostat which in turn modulates face and bypass dampers at the corresponding cold water coils.

No attempt is made to control the relative humidity at a fixed point in summer so long as it remains below a predetermined maximum value. In this way advantage is taken of the many hot, dry days in this locality when the humidity is so low that sensible cooling only is required and often only to a point which will produce a predetermined effective temperature at a higher dry bulb temperature.

During the cooler damp weather when the inside moisture content is high, the relative humidity is permitted to rise as high as 60%, but the dry bulb temperature is automatically controlled at a relatively lower point, thus maintaining comfort conditions with



Three unit conditioners in the central fan room on the fifth floor deliver conditioned air to the general offices.



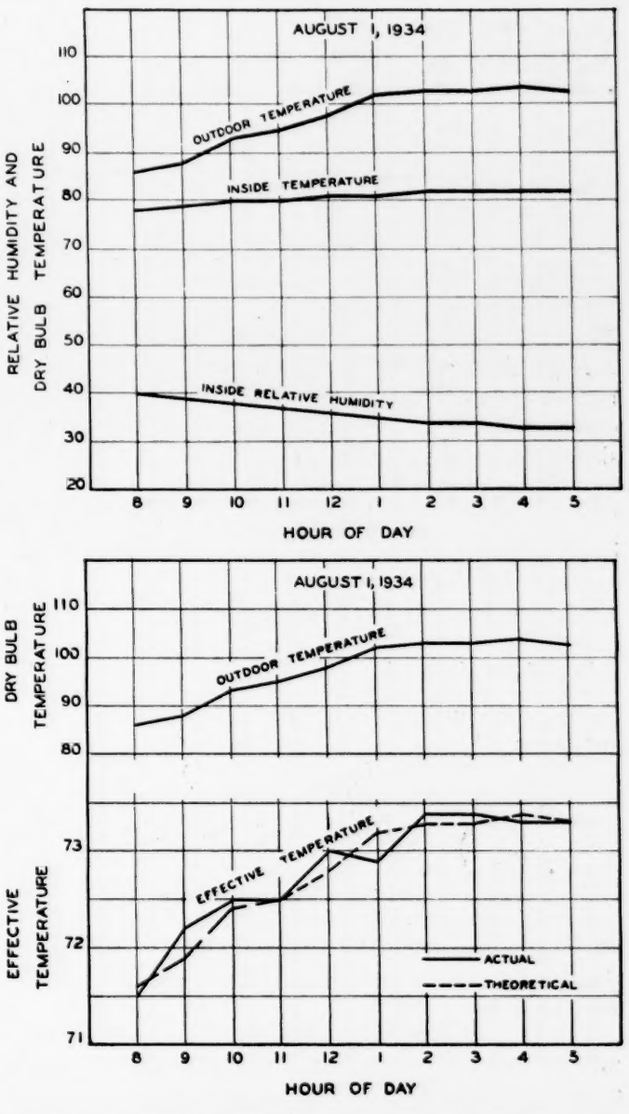


Fig. 1. (Above) Summer comfort zone for which the controls are set. Fig. 2. (Upper right) Results obtained in one of the zones on the fifth floor on a typical summer day. Fig. 3 (Lower right) Comparison of actual and theoretical temperatures shows accuracy with which controls operate.

a minimum of latent heat removal and maximum economy.

Should the relative humidity ever exceed 60% inside under extremely wet conditions, when it is unnecessary to remove any sensible heat due to the cooler temperatures, an auxiliary switch in the relative humidity compensator permits a reduced quantity of air to pass through the cold water coils so as to remove as much moisture as possible with a minimum of sensible cooling.

The schedule which was set up for summer operation is as follows:

Outdoor Temperature	Indoor Effective Temperature
75°	70.5°
80°	71.0°
85°	71.5°
90°	72.0°
95°	72.5°
100°	73.0°
105°	73.5°

The indoor dry bulb temperatures are limited to 76° low and 82° high, and the indoor relative humidities are limited to 30% low and 60% high. Fig. 1 therefore represents the comfort zone for summer operation.

Recording charts are taken constantly of outdoor and indoor temperatures and indoor relative humidities in all zones. Fig. 2 illustrates the results obtained in one of the zones on the fifth floor on a typical summer day. The values have been transposed hourly from the original charts.

Fig. 3 illustrates the accuracy to which the inside effective temperatures on this typical day were held to the schedule which had been set up. The broken line represents the theoretically correct inside effective temperatures and the solid line represents the actual inside effective temperatures. The actual values are based upon the combined effect of the actual inside dry bulb temperatures and relative humidities shown in Fig. 2.

The winter dry bulb temperature is controlled by modulating face and bypass dampers at the heating coils in accordance with the demand of thermostats in the corresponding zones so as to maintain a fixed temperature. The relative humidity is also maintained at a fixed point by the use of water sprays in each of the conditioners controlled by humidity controllers in the corresponding zones.

During both the heating and cooling cycles the outdoor conditions are measured and a maximum of outdoor air is automatically taken into the system whenever the outdoor air can be used to assist in either heating or cooling. This latter arrangement of equipment is known as an economizer control and is of especial advantage during the early and late part of the cooling season when the mornings or evenings are cool.

The air conditioning system was designed by the engineering staff of the Oklahoma Gas and Electric Company, S. L. Rolland in charge. Installation was made by the Dolan Heating Co., Oklahoma City.

GETTING DOWN TO FUNDAMENTALS

6—What Factors are Really Critical in Fixing the Amount of Ventilation Air Necessary?

Foreword

IN previous articles in this series the nature and direction of flow of the heat quantities on which the usual estimate is made have been described. They were shown to be divisible into (a) transmitted heat, (b) heat from filtration air, and (c) heat from ventilation air. It was also noted that these quantities can be expressed mathematically in the following equations:

$$\text{Transmitted Heat} = H = AU\ (t_i - t_o) \quad (1)$$

$$\text{Heat from Filtration Air} = F = \frac{C(t_i - t_o)}{55} \quad (2)$$

$$\text{Heat from Ventilation Air} = V = \frac{C_v(t_i - t_o)}{55} \quad (3)$$

In these equations: H, F, and V are all in B.t.u. per hour:

A = Area, sq. ft. of surface through which heat passes
U = The transmission coefficient, air to air
C = Volume of filtration air flowing, cu. ft. per hr.
C_v = Volume of ventilation air flowing, cu. ft. per hr.
t_i = Temperature of indoor air, °F.
t_o = Temperature of outdoor air, °F.
1/55 = 0.018 = heat to raise 1 cu. ft. of air at 70° through 1°

Succeeding articles have been devoted to noting the state of the information available for securing suitable values for substitution.

Tables were presented indicating present ideas as to what should be used for t_i and t_o under both summer and winter conditions. Then methods of finding values for C in Equation (2) were described, with tables.

The two last preceding articles have dealt with the complicated question of determining the amount of ventilation air, C_v, for use in Equation (3). Values as usually published were presented and found to lack specificness. Then the values as fixed by legal enactments were tabulated and shown to be fairly specific in some cases and exceedingly general in others.

Presentation of information on quantities of ventilation air as given in preceding articles practically exhausts the sources ordinarily available. Where the figures given are too general to permit fixing the quantity for a particular job, the user is driven to the necessity of falling back on his own experience or on fundamental principles bolstered up by whatever he can find either by reasoning or by practice on similar work. Of these several procedures certainly the most satisfactory and reliable is to go straight back to the fundamentals themselves.

We have already noted that for practical purposes it is convenient to divide applications of ventilation air in buildings into Human Ventilation and Process Ventilation. We have also pointed out that there is no justification for using ventilation air at all unless there is a clearly defined purpose in doing so. Having decided that its use is necessary, then economy points toward the use of the least quantity which will accomplish the objective. This thought would imply that the fixing of the amount of ventilation air ought to be a two-step process, first, clearly defining *why* it should be used, and second, deciding on the basis of accomplishing the specific objective set.

Now let us apply this general procedure in an attempt to arrive at air quantities for Human Ventilation purposes. We will consider human ventilation to be as defined in an earlier article.

Keeping in mind that the air already in a building, and the air constantly finding its way in and out by filtration, is essentially the same in most of its properties as any additional air which may be deliberately circulated, it would seem reasonable to decide to always use the air either already at hand or which comes to hand involuntarily in preference to deliberately bringing in more air. From this it follows that the only reason why ventilation air is deliberately introduced and exhausted must be because there are circumstances where this process is necessary. Where and what are they?

To get at the fundamental conception it is helpful to consider that ventilation air, strictly speaking, is always circulated into and out of a building—never recirculated. Some of the air is recirculated, perhaps, or even all of it, but the air which goes to really accomplish ventilation is, by definition, deliberately brought in and just as deliberately taken out again by some means or other. Clear comprehension of this fact gives the answer to the "why" of its use. Simply stated we get the general principle as follows:

1. In human ventilation applications the only real reason for using ventilation air is to carry away something which either cannot be gotten rid of by using the air already in the building or the air which circulates through the building by filtration, or else it is more desirable to use air for this purpose than to use some other substance as the carrying agent.

This seems extremely simple, and is. Trouble arises in the application only because of the complications which come with attempts to set up the objective specifically sought in a particular case. This resolves itself into an analysis to determine just what is to be carried away. Let us see if what is to be carried away can be set down systematically.

First let us note what is given up by the human being to the air when living normally as we in this country think of it. The items are:

(a) Air (used in breathing)
(b) Heat (as long as the surrounding air is at a temperature lower than body temperature)
(c) Moisture
(d) Odorous substances (picked up by the air in the course of its circulation)
(e) Bacteria or living organisms, or quantities of solids in the form of dust.

Regarding item (a) there is no choice but that the air used in breathing be expelled into the general body of air surrounding the person except in special cases where expired air is carried away separately. Under usual conditions the breathed air mixes freely with other surrounding air. The two quantities diffuse more or less freely together and the whole mass takes on properties intermediate between the outdoor air, the unbreathed indoor air, and the breathed indoor air. This change presents the possibility of measurements and many ingenious devices have been devised or adapted to accomplish them. The idea is that the quantity of air required could be found by direct measurement supplemented by simple and plausible reasoning.

One such argument runs as follows: An adult expires about 30 cu. in. of air each time he breathes. Allow 16 respirations per minute and the volume of breathed air is nearly 0.30 cu. ft. per min. This is equivalent to 18 cu. ft. per hr. This should be the quantity (C_v) required, provided there was nothing but item (a) to consider.

It was early noted, however, that supplying this amount did not seem to work out in practice where item (a) could almost never be treated alone.

The Carbon Dioxide Index

Another method of direct measurement was hit upon in the form of the carbon dioxide concentration. It was argued that this concentration should be kept at not more than 7 parts per 10,000, although just how the seven was determined is not clear. At any rate support was found for the idea and a formula for C_v in terms of cu. ft. of ventilation air per person per hour was developed as follows.

$C_v = \frac{a \times c}{n - 4}$ where a and n are parts of CO_2 per 10,000 at expired air condition and desired purity standard respectively, and where c = cu. ft. of air breathed per hour.

This equation has been widely printed and is found in early editions of most standard handbooks and in older textbooks. If c is taken at 18 cu. ft. per hr., a at 400 and n at 7, then we get C_v equal to 2400 cu. ft. per hour per person.

Calculations of this general kind lie behind many of the values of C_v given in published tables such as those already shown in preceding articles of this series. The author either set the figures for substitution where he felt they should be, or else modified the figures as found by the formula to meet his ideas or experiences.

Use of this formula was probably the original attempt to go to fundamentals to get a basis for arriving at the quantity of ventilation air required. The figures resulting have profoundly affected all human ventilation practice in buildings for a long period.

The underlying reasoning substantiating the use of the carbon dioxide concentration formula is based on the theory that carbon dioxide concentration is itself a measure of air purity; and that since if air is recirculated over and over again the carbon dioxide concentration will naturally increase, therefore this concentration is a direct indication of its fitness for use for breathing purposes.

It seems doubtful if any fault can be found with this general line of reasoning. That is what made the theory so plausible and perhaps goes a long way toward explaining its general acceptance.

Even though the theory itself may be perfectly sound there has gradually developed a considerable mass of evidence that the limits of concentration as set in the usual calculations are grossly misplaced. Experimenters showed that for short periods at least, humans are apparently not badly affected even where concentrations of CO_2 of 10% to 25% are present. If such values are substituted in the formula, the quantity C_v is reduced to a negligible quantity.

All this evidence has caused such serious doubt to be raised that a great many engineers now consider that the formula just given is without practical merit and that results obtained by its use are open to question.

The two attempts to go to fundamentals just outlined exhaust those of record so far as the effects of breathing on the ventilation air quantity are concerned. What are we to conclude?

The conclusion is that neither of these attempts is particularly satisfactory or convincing. Further it appears that there is at least as much fundamental merit in the figure of 18 cu. ft. per person per hr., arrived at by the method first outlined as there is in figures at 1800 to 2400 cu. ft. per person per hr., arrived at by the use of the formula for carbon dioxide concentration as so often applied. The general conclusion is that quantities required for breathing purposes are really small and it is doubtful if they are critical in fixing quantities of ventilation air required in practice. In other words if nothing had to be considered except air for human breathing, a consideration of the fundamentals indicates that ventilation air would but rarely be required over and above that which circulates involuntarily by filtration in the ordinary building. This consideration does not fix ventilation air requirements. This conclusion agrees closely with what seems to be the weight of current opinion and practice.

Heat and Moisture Fundamentals

Now we can turn to item (b)—Heat—given up by the human body to the surrounding air in the ordinary case. While it might be possible to consider item (c) —Moisture—separately from item (b) it is much more convenient to consider both of them at once for they are intimately related.

Our purpose is to consider these items only as they affect the fundamentals of arriving at quantities of ventilation air for practical use. This being so it is not necessary to go into all the complicated theory of the interrelations between the production of heat in the

body and its transfer to the surrounding air and other objects. It is necessary though to do this to a limited extent and also to keep the fundamentals of heat transfer carefully in mind.

The usual argument used when the attempt is made to fix ventilation air quantities by heat and moisture considerations runs as follows. The body is steadily producing heat. The amount produced varies with rate and kind of activity, clothing, and a number of other factors. This production rate is largely involuntarily. An essential function of the air surrounding the person is to act as an agent in removing this heat at a rate and in a way that will keep the person "comfortable." Thus, continues the argument, the thing to do is to supply enough air in such a way that this will be accomplished.

All this sounds exceedingly plausible. To date there is little or nothing to indicate that the argument is not thoroughly sound in its fundamentals. Certainly heat is produced, and certainly it must be removed. Air can surely be the agent for picking this heat off the body, and the picking off ought to be accomplished without either discomfort to the body or by placing it in danger from any other troubles. All this, however, just as in the case of the carbon dioxide concentration index, does not indicate, simply because the essential facts are sound, that all the conclusions and practices built up around the reasoning are also logical or defensible. Judging by the wide diversity of these conclusions and practices it is evident at once that either all of them cannot continue to deal with fundamentals throughout or else that a great variety of possible practices and conclusions can logically result from the few fundamentals.

Careful consideration points toward the thought that some of both situations are present. Plenty of practices now current eventually are likely to be shown to be wrong in their pursuit of the fundamentals while there is no doubt but that there is a variety of ways of transferring the heat produced in the body to the surrounding air.

Before an inquiry of this nature to establish air quantities can get far it is necessary to know with some certainty the amounts of heat which the individual produces under the various conditions usually encountered. This subject has been studied by a number of investigators and while they agree well on the nature of the variations and what causes them, they do not agree closely in the quantities of heat reported. Table I gives a list of the quantities as reported by several investigators.

TABLE I. HEAT PRODUCED BY HUMAN BEINGS

Activity	Emission, Average, In B.t.u. Per Hr.	
	Earlier Tests	Recent Tests[4]
Lying in Bed	—	238
Sitting Down	384[1]	250
Standing	431[1]	262
Brisk Walk	1731[2]	714
Limit of Endurance	2555[3]	2618

[1] *Reported by Houghton, Teague, Miller, and Yant at A.S.H.V.E. Research Laboratory.*
[2] *Reported by Douglas, Haldane, Henderson, and Schneider.*
[3] *Reported by Benedict and Carpenter for "Very severe exercise."*
[4] *Reported by Dr. and Mrs. Benedict, Carnegie Institution.*

Becker and Hamalainen investigated heat production of men engaged in various kinds of work and their rounded results are shown in Table II.

TABLE II. HEAT PRODUCED BY MEN WORKING AT VARIOUS TRADES

Occupation	B.t.u. Per Hr.
Bookbinder	625
Carpenter	760 — 960
Metal Worker	860
Sawyer	1800
Painter	875
Shoemaker	660
Stone Mason	1500
Tailor	480

It has been shown that mental effort does not use up physical energy rapidly and that a man who is just sitting is producing heat at about the same rate as one who is sitting and thinking.

The figures just given include nearly all of those in existence. There are many gaps as well as considerable disagreement. Moreover the figures must be used with care for they vary between the sexes, with the hour of the day, and with the number of hours after eating. The data are not in good shape.

With this true of the data on the heat production side the situation is still more confusing and in still more of a jumble when the matter of how this produced heat is transferred away from the body is considered. In this field there are only scattered bits of data. For instance, it has been usually assumed that all the produced heat passes to the surrounding air. Obviously this is by no means always true for that part which leaves the body by radiation may or may not be picked up by the surrounding air. So also when there are hot bodies like radiators present they pass heat to the human body if they are at a temperature above body temperature. How this heat affects the rate of body heat production or how or to what extent this heat changes the methods of heat transfer from the body are points on which there is no existing information. The whole matter is complicated, hard to examine experimentally and does not lend itself to an analytical solution.

General facts concerning the methods of heat transfer and the control which the nervous system exercises over them are fairly well established. The skin temperature is kept fairly constant by this control. It operates to cause heat to leave the body surface, and seems to use perspiration as the means of achieving control. As the perspiration rate increases the surface of the body tends to become wet. If the air sweeping the body evaporates the perspiration fast enough the surface will not actually become wet. If evaporation is not rapid enough then liquid droplets form and may actually run off carrying heat with them. Such heat is not picked up by the surrounding air.

Consideration of these facts is what leads to the assumption so often stated that temperature and humidity of the surrounding air together with its speed of circulation are what govern the heat transfer from the body. Such statements while undoubtedly correct within limits should not be accepted as gospel truth. There are certainly other factors besides these, such as temperatures of surrounding objects.

Heat and Moisture Data

With this discussion out of the way, we can proceed to look about to see what is available in the way of actual numerical data which might be of help in determining ventilation air quantities. Examination of the tables showing temperatures and humidities commonly maintained in human ventilation applications shows that the summer range is from 70° and 60% R.H. to 80° and 40% R.H., while the winter range is from 60° to 90° with relative humidities of 40 to 60%. As the winter range includes also the summer range, the zone which we need consider lies between 60° and 90° with humidities of 40% to 60%. There is some experimental evidence that at 60° about 15% of the heat produced is transferred by evaporation to the surrounding air from the body of a man at rest in still air, with 85% transferred by other methods. At 90° about 70% is transferred by evaporation and 31% by other methods. When a man is doing hard physical labor in still air about 45% of his heat reaches the air by evaporation at 60° and about 70% at the higher temperature.

With such figures and those in Tables I and II calculations can readily be made showing how the heat produced is transferred from the body in still air conditions. Thus if we take 250 B.t.u. per hr. from Table I as being correct, we apply 15% and 85% figures and the 30 and 70% figures just noted and find that from 37½ to 50 B.t.u. per hr. should leave the body by evaporation while from 212½ to 175 B.t.u. are transferred by other methods.

Now the question is—Granted that these heat quantities are correct how much air must pass over the body to remove this heat? Since we know that the 175 and 212½ B.t.u. are in terms of sensible heat and also know that every cu. ft. of air whose temperature is raised one degree will require 1/55 B.t.u. to accomplish this rise we can compute $175 \times 55 = 9600$ and $212\frac{1}{2} \times 55 = 11{,}700$. Thus if the air as it swept over the body had its temperature raised one degree we would need from 9600 to 11,700 cu. ft. per hr. per person to pick up the sensible heat. If the temperature were raised 10° then we would need from 960 to 1170 cu. ft. per hr. to do the job. If the rise were 20° we would need 480 to 585 cu. ft. per person per hr. This illustrates very well that the air quantity depends on the temperature rise.

This makes the question become "What temperature rise can we get in practice?" This in turn depends almost entirely on how the air is circulated over the body. If it passes rapidly there is little chance for it to be warmed. If slowly then the temperature has time to rise further. In practice the rise varies all the way from a very few degrees up to as much as 25 or even 30°.

We can very well again ask "Does this consideration of the fundamentals lend any help in practice in fixing the quantity of ventilation air?"

Again the answer is that it does not. Instead it serves to further accentuate the conclusion that so far as heat and moisture quantities are concerned, it is extremely doubtful if they can be made the basis for developing any general standard of procedure for measuring the range of figures commonly given in published tables fixing the ventilation air quantities.

The discussion just given does show that with the data now available the nature of the heat quantities can be approximately estimated. It might have been shown further that those quantities can be made to serve to estimate the magnitude of a part of the heating or cooling load but they do not necessarily fix the amount of air which must be deliberately brought into and out of the building.

The words "necessarily fix" are used after consideration for it is possible that with certain arrangements of equipment and certain methods of operation the heat and moisture given up by persons do fairly definitely fix the amount of ventilation air required. The essential point is that cases must be considered separately.

Cases of Heat and Moisture Conditions

To permit better appreciation of the correctness of this conclusion let us take several cases such as occur frequently and note the effect which heat and moisture from persons have on fixing the quantity of ventilation air.

> Case I—A school house, built for winter operation. No cooling equipment but with a humidifier for adding moisture to the air which passes through it. A split system with fan, but with direct radiators to take care of heat quantities arising from all but human heat and moisture.

Suppose first that the fan is operated without any ventilation air at all. Since there is no provision for removing the heat and moisture steadily produced by each person in the building, the circulating air will steadily get warmer and more moist. The means available to check this increase under the conditions of the case are the filtration air passing through the building and the heat which leaves through the building materials. Water for the humidifier enters the building and *could* be used to carry heat away but does not do so under the conditions of this case. If the humidifier were operated *as a humidifier* under these conditions it would simply put more moisture into the air and make conditions worse. Under the assumption of this case it cannot act as a dehumidifier.

Evidently here is a case where the heat and moisture from persons may get to be critical in fixing the air quantity, for the density of population in school buildings is great and good construction keeps the amount of filtration air low.

(Continued in an early issue)

Photos courtesy Air Reduction Sales Co.

Safe Piping Jobs Aim of New Standards

WITH seven years of committee work behind it, the "Code for Pressure Piping" has appeared in print as an American Tentative Standard. Copies of this publication may be obtained from the American Standards Association, 29 W. 39 St., New York City. The published price is $1.00 per copy with a 20% discount to association members.

The code is sub-divided into four separate sections, one of which covers power piping, one is devoted to gas and air piping, another to oil piping systems, and the fourth deals with district heating piping. There are also sections on fabrication details and on materials. An appendix describes a system recently adopted by valves and fittings manufacturers for marking their products. Refrigeration piping is not included, although it is expected that a code covering this will be added shortly. Water supply piping is omitted because of lack of agreement on the subject.

Primarily the code is intended to insure safety and to be in the nature of minimum requirements necessary to accomplish this. No claim is made that the best or most advanced practices possible are codified. Another purpose of the code is to serve as a basis to guide local legislative bodies in framing ordinances to insure safety in pressure piping work. It is possible that the code may be used also by designers, regardless of whether or not it finds its way into legal enactments.

Each of the sections dealing with a particular kind of piping includes provisions regarding choice of materials and use of dimensional data to cover the elements of which the piping system is constructed, method of erection to be followed, a suitable formula for determining necessary pipe wall thicknesses to withstand the imposed temperatures and pressures, and testing methods to be followed both before and after erection.

It should be especially noted that this code is not intended to apply to piping where a sub-standard job would not present any particular safety hazard. Because of this the code specifically excludes from its provisions building heating systems operating at 15 lb. or less, plumbing piping, sprinkler systems, or roof and floor drains. District heating distribution piping carrying pressures of 15 lb. or less are also not included in the code provisions. It does apply to all high pressure steam generating plants, high pressure heating piping in buildings, and to high pressure steam and hot water distribution piping systems.

The two sections of most immediate interest are Section 1—Power Piping, and Section 3—District Heating Piping. In general form, these two sections are similar. A great deal of the wording of the provisions is identical in each section. Both specify the same requirements for dimensional standards and materials, and use the same formula for pipe wall thickness. Section 3 on District Heating Piping carries its own requirements on stop valves; on drain, drip, and steam trap piping; on tests of piping after installation; and on installation of reducing and relief valves on consumers' premises.

Following is a summary of important points in connection with the District Heating section of the code.

Scope of Requirements

This section covers the design, manufacture, test, and installation of district heating and central heating piping systems (away from the plant) for the distribution of steam or hot water. Piping in the district heating and central heating generating plants is covered by Section 1 of the code.

District and central heating piping systems include all distributing piping for steam or hot water produced in district heating and central heating plants whether the piping is installed underground or elsewhere and distributed at pressures in excess of 15 lb. per sq. in. gage.

This section does not apply to equipment, apparatus, or pipe connections which are a part of apparatus, nor does it apply to low pressure heating piping within buildings, roof, and floor drains, or plumbing and sewers.

Adherence to American Standard dimensions for flanges and pipe fittings is strongly recommended wherever practicable. However, paragraphs, tables, or notations specifying these and other dimensional standards in the code are not mandatory provided other designs of at least equal strength and tightness and capable of withstanding the same hydrostatic test requirements are substituted.

Materials

Under the heading "Materials" it is provided that the materials employed shall be capable of meeting the physical and chemical requirements and tests of the latest revisions of accepted standard material specifications. The standards listed are largely those of the ASTM, and a table gives them by ASTM number for bolts, fittings, valves, flanges, pipe, and tubing. It is also provided that "Should any materials or methods of manufacture be developed which are not covered by any of the specifications given, piping, valves and fittings made from such materials or by such methods may be used and full advantage may be taken of the qualities of such materials and methods of manufacture pending the preparation and approval of specifications therefor."

It is made mandatory that valves be (1) of the design which the manufacturer thereof lists for the service and (2) of the materials allowed by the code for the pressure and temperature. Body metal thickness of steel valves shall not be less than that of fittings for corresponding material, size, and rating. Each valve, of a size permitting, shall bear the maker's name or trademark and reference symbol to indicate the service conditions for which the maker guarantees the same.

Gate valves only are to be used as stop valves in the mains. Valves may be either of the rising or non-rising stem types. The dimensions of flanges or welding ends, and the material of all valves including reducing and automatic control valves, are to conform to the specific requirements of this section and in the case of flanged valves, to the B16 series of American Standards for cast iron and steel, and the M.S.S. Standard Practice SP-2 for bronze corresponding to the maximum pressure and service for which the valve is to be used. Welding-end valves may be used and welded directly into the line.

The provisions covering reducing and relief valves on consumer's premises are here reproduced in full as they are specific and fall within the work sometimes considered in the building plan when district steam is being used.

(a) Where the street pressure exceeds 50 lb., a pressure reducing valve set at 50 lb. or less shall be provided near the point of supply in consumer's premises to regulate the pressure in all building heating apparatus. A relief valve set at a safe working pressure, but not to exceed 50 lbs., shall also be provided if the consumer's piping or equipment is not capable of withstanding the full street pressure, and in any case where the street pressure exceeds 50 lb., except that where two pressure-reducing valves are installed in series, no relief valve is required.

(b) The capacity of relief valves shall be adequate to prevent more than 33 1/3 per cent over-pressure with full steam flow. Relief valves shall be vented to the atmosphere, and proper protection shall be provided to prevent injury or damage caused by escaping steam.

(c) The use of a hand-controlled by-pass around a reducing valve is permissible. The by-pass shall not be greater in capacity than the reducing valve, unless the piping is adequately protected by relief valves or is of a construction which can withstand full street pressure.

(d) A pressure gage shall be installed on the low pressure side of a reducing valve. Where two reducing valves are installed in series, the pressure gage shall be installed on the low pressure side of the second reducing valve.

(e) The flange dimensions, construction, and material of reducing and relief valves shall conform to the requirements of this section for stop valves for the pressures and temperatures to which they may be subjected.

It is recommended that all pipe threads on pipe, valves, fittings, etc., shall conform to the American Standard for Pipe Threads (B2). Flanges shall be attached to the pipe by threading (except where prohibited under the specific requirements of this section), by lap jointing (Van Stone), by welding in compliance with the requirements of Section 5, Chapter 3 of the code or by other approved methods.

Gaskets are to be made of metal, asbestos, or other material which will not burn, char, or change in character so as not to perform the service intended at temperatures up to 750 F.; they shall be proof against deterioration by the fluid conveyed. Rubber gaskets may be used for hot water service at temperatures not in excess of 250 F.

Expansion

Thermal expansion of pipe lines shall be provided for by pipe bends, offsets, expansion joints, or changes in direction of the pipe line itself.

Expansion joints of either the slip-sleeve, diaphragm, or corrugated types may be used when designed for the given pressure and temperature. Where expansion joints are used they shall meet the following requirements:

(1) Materials used shall conform to the requirements of this section for the operating pressure and temperature.

(2) Structural and working parts shall be of ample proportions with flanges, where used, conforming to American Standards for the operating pressure and temperature.

(3) The design of the piping shall be such that its expansion shall not exceed the allowable maximum travel of the expansion elements.

(4) Provisions shall be made against complete disengagement of the working parts while in service.

Unsupported corrugated copper expansion joints are not to be operated at service pressures in excess of 25 lb. per sq. in Where copper corrugated expansion joints are equipped with external rings or sleeves, they may be operated at pressures not exceeding 200 lb. per sq. in.

Nothing in this paragraph is to be construed as limiting the use of expansion joints, corrugated pipe, or bends made of the same material and dimensions as the rest of the pipe.

Support of Piping

All piping is to be carried on adjustable hangers or properly leveled supports and so anchored and guided as to prevent undue strains in piping or equipment served. Hangers and supports to be made of durable materials, and it is strongly recommended in general that they be non-combustible. The use of wood and wire as supports is limited to outside service and to temporary service in plant buildings and tunnels during the erection of piping. Wood and wire may be used as supports only where they will not be affected detrimentally by atmospheric or operating conditions, and in the case of wooden supports, provision shall be made for all piping used for conveying fluid at temperatures above 230 F. so that this piping shall be spaced or insulated from such wooden members to prevent dangerous heating.

Hangers and supports are to be so installed as not to interfere with the free expansion and contraction of the piping between anchors. Piping shall be anchored in such a way that movement will be absorbed by the expansion joints or by the inherent flexibility of the piping. Anchors shall be positive and strong enough to resist any normal strain. Pipe hangers, supports, anchors, etc., shall be fabricated in accordance with Section 5, Chapter 1 of the code.

Where steam pipes pass through walls, partitions, floors, beams, etc., constructed of combustible material, a protecting metal sleeve or thimble is to be provided which gives a clearance of not less than ¼ in. all around the pipe and covering under hot and cold conditions. In the case of steam pipes, where passing through metal partitions, etc., a clearance of at least ¼ in. under hot and cold conditions shall be left all around the pipe, or pipe covering. In any case, if the fluid temperature exceeds 250 F., the pipe shall be insulated inside the sleeve with a covering of at least standard thickness.

In no case shall walls, floors, partitions, beams, etc., be cast or solidly built up around and in contact with a steam or hot water pipe. Where it is necessary to install such a pipe in a concrete floor or other building member, it shall be protected for the entire length of bury with a suitable protecting sleeve of steel pipe, cast iron, wrought iron, or of tile. In the case of pipes passing through walls, floors, partitions, etc., which must be kept watertight, some means of packing shall be used.

Drip and Drain

Drains or drips are to be provided to drain the water of condensation from the steam piping and equipment wherever it may collect. Blowoff outlets for air or condensate open to atmosphere, or connected to sewers, sumps, or receivers, shall be provided at all low points and elsewhere when necessary for the proper operation of the pipe line and equipment. Each drip, drain and blowoff shall be controllable by at least one stop valve, located as close as practicable to the point of drainage.

Drip lines from steam headers, mains, separators, and other equipment shall be properly trapped with the traps installed in accessible locations. By-passes shall be provided around steam traps unless the traps may be replaced by a spare or drainage continued by means of an open drip to the atmosphere or elsewhere at times when the trap is serviced or found inoperative.

Drip lines from steam headers, mains, separators, or other equipment operating at different pressures, shall not be connected to discharge through the same trap. Where two or more drips operating at the same pressure discharge into the same trap, a check valve and a stop valve shall be placed in each line. Where several traps discharge into one header under pressure, or which may be under pressure, a stop valve and a check valve shall be placed in the discharge line from each trap.

The weight of trap discharge piping shall be the same as the inlet piping unless the former is vented to atmosphere or operated under low pressure and has no stop valves. The trap discharge piping in all cases shall be of a weight suitable for the maximum discharge pressure to which it may be subjected. Trap discharge piping, if vented to atmosphere, shall be properly run to facilitate its self-discharge and its outlet shall be so located, or proper protection shall be provided, to prevent human injury caused by escaping steam or hot water. All trap discharge piping shall be protected against freezing, where necessary.

Tests

All materials shall be capable of meeting the inspection and test requirements described in the corresponding standard specification. Unless otherwise specified, the manufacturer's certification that those tests have been met shall be accepted as satisfactory.

The inside of all pipes, valves, fittings, traps, and other apparatus shall be smooth, clean and free from blisters, loose mill scale, sand, and dirt when erected. All lines shall be blown before placing in service, if practicable.

All valves, fittings, etc., shall be capable of withstanding a hydrostatic shell test, made before erection, equal to twice the basic steam service pressure, except that steel fittings and valves shall be capable of withstanding the test pressures as given in the accompanying table. Pipe shall be capable of meeting the hydrostatic test requirements contained in the respective material specification under which it is purchased.

HYDROSTATIC TESTS FOR STEEL FITTINGS AND VALVES

Primary Steam Service Pressure Ratings lb. per sq. in.	Test Pressure lb. per sq. in.
150	350
300	750
400	1,000
600	1,500

Whenever practicable, in the case of any under-

(Concluded on page 73)

ABSTRACTS of Current Papers, Books and Pamphlets

Heating and Air Conditioning

This is a new title for the well known textbook "Heating and Ventilating" by Allen and Walker. The change in name accompanies the addition of much new material in the chapters relating to air conditioning. The additions have been partially offset by the condensing of other chapters, particularly that on hot water heating, so that the size of the book has been increased only 20 pages. A large number of revisions have been made in other sections both to bring the book up to date and to clarify certain of the more difficult portions.

Additions have also been made in the chapter on temperature control and heat losses from buildings. The chapters on heat and the properties of steam have been combined and the order of the chapters changed somewhat so that the material is arranged in a more logical manner.

As in the former editions, principles rather than methods and facts rather than opinions have been presented. These together with the improvements brought about by the addition and changes in material make the book more valuable than ever as a college textbook.

[*"Heating and Air Conditioning" written by John R. Allen and James H. Walker and published by the McGraw-Hill Book Company, New York. Fourth edition; cloth-bound; 6 x 9 in.; 444 pages. Price, $4.*]

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Modernizing Buildings for Profit

The past few years have shown the excellent opportunities that exist for the contractor, architect and owner in modernizing buildings so that they may compete with the more modern structures. In this book there has been gathered together a number of ideas, check lists and case histories of modernizing work which should prove extremely helpful to anyone planning to do or to have modernizing work done.

Perhaps the best method of showing how well the author has treated the subject is to list the chapter heads. They are: Out of the Red by Modernizing; Before You Go Ahead; Types of Modernizing; How much Modernizing; How to Get Started; How to Use the Case Histories; The Home: Exterior and Structure, Basement and Laundry, Living Room, Dining Room, Kitchen and Pantry, Bedrooms and Baths, Storage and Attic, Plumbing, Heating and Air Conditioning, Electrical Equipment and Lighting; Apartments, Hotels; Restaurants and Bars; Stores and Shops; the Office Building; Theaters.

[*"Modernizing Buildings for Profit" written by Kenneth K. Stowell and published by Prentice-Hall, Inc., New York. Cloth-bound; 9 x 12 in.; 231 pages. Price, $6.50.*]

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Consumer Study, Portland, Me.

Another in the series of booklets on "Consumer Use of Selected Goods and Services by Income Classes" has been published by the Department of Commerce. This one is devoted to Portland, Me. This series of books represents the first attempt of its kind to correlate the income and consumption of goods and services.

Regarding heating in Portland, Me., tenants and home owners are alike in providing evidence that, irrespective of materials used in house construction in this city, the central heating plant is the most commonly used equipment for house heating. Over 70% of these homes have central plants. As compared with other types of heating systems, by far the highest percentage of these homes have steam or vapor plants. Next in importance, on the basis of present use, is the hot water system. A few families use warm air furnaces. Approximately 24% of the Portland families do not have central plants at all, but rely on heating stoves.

Almost 87% of the families that use stoves are tenants and about two-thirds of the stove-using families reported incomes of less than $1000 for the year 1933.

The relationship between family income and the use of central heating apparatus in Portland homes is indicated by the fact that heating plants are used by more than 95% of all families with incomes of more than $2000. Moreover, through successively lower income ranges, there is a continuous drop in the proportion of homes supplied with central heat.

Coal is used for house heating purposes by more than 80% of all families in Portland. Fuel oil is consumed by approximately 12% of the families. About 15% of the families that own their own homes burn oil, but this fuel is used by only about 10% of the tenant families.

While the use of coal is too general to be definitely associated with the low income classes, it is interesting to find that about 35% of the coal-burning families reported incomes of less than $1000. Over 80% of those few families (0.7% of Portland's family population) that used wood for heating fuel, reported incomes of less than $1500.

The study was made by Ada Lillian Bush, Chief of the Consumer Market Section, of the Marketing Research and Service Division. The factual data provided in this series, it was stated, are designed to be of practical value to manufacturers, wholesalers and retailers of the specified commodities whose sales territories include this city or similar communities. How the information can be applied in sales planning, advertising and for other business purposes is illustrated in a section of the report on "Suggested Use of this Material."

[*"Consumer Use of Selected Goods and Services, by Income Classes, Portland, Maine": Market Research Series No. 5.3, by Ada Lillian Bush. Size 8 x 10½; 31 pages. Obtainable from the Department of Commerce, Washington, D. C., or branch offices; price, 10 cents.*]

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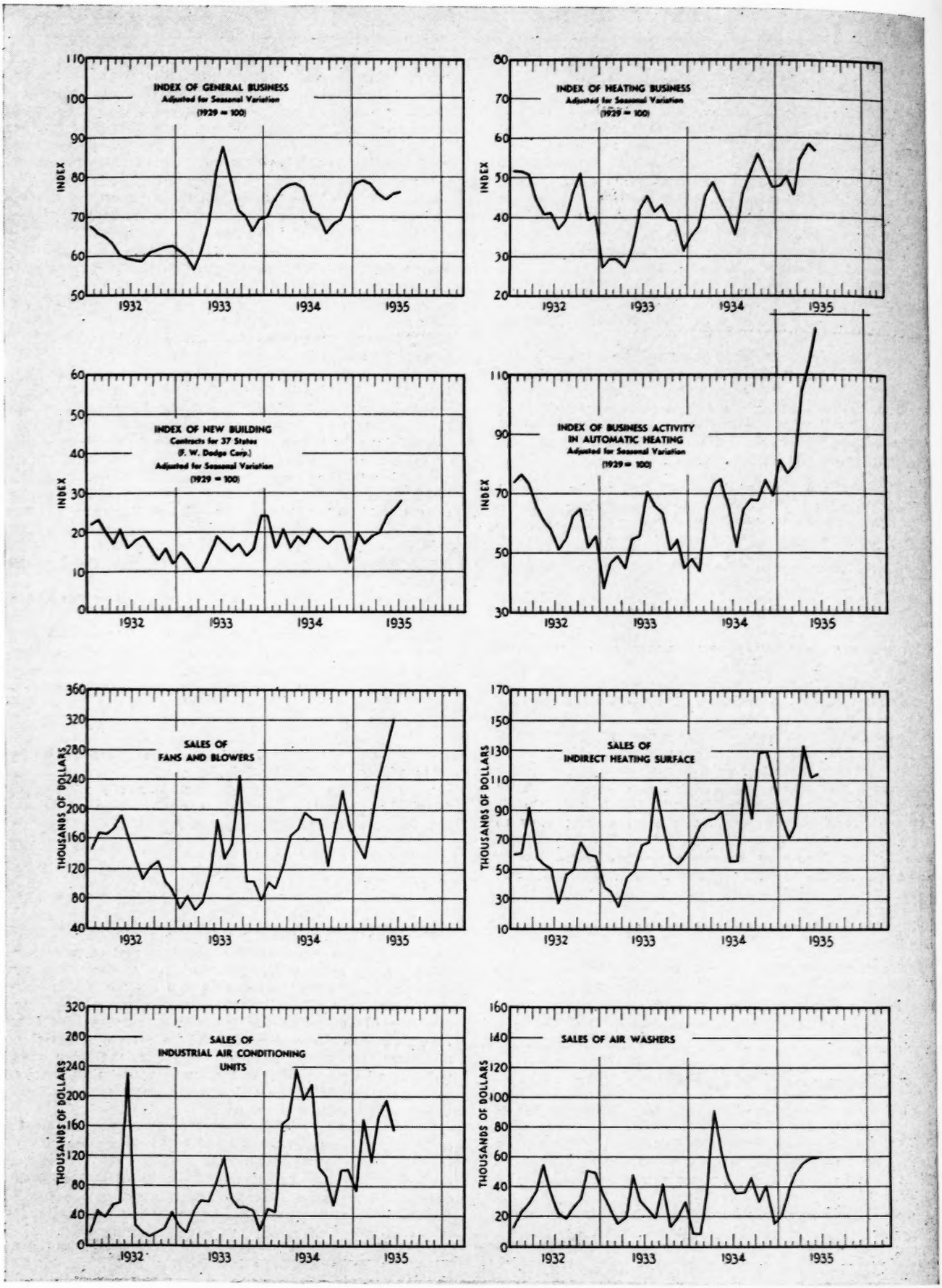
Fans

Here is a book which fills a definite need. While a large amount of material is available on the subject of fans, there has been no book which discusses the subject from the standpoint of the user. According to the author the primary purpose of the book is to enable the user to make a better selection of equipment for the various service conditions to which fans are applicable. While certain material of a theoretic or design nature is included, the main viewpoint at all times is that of the purchaser who must select fans from various types and adapt them to the conditions under which they will be used.

The first portion of the book reviews the commercial equipment which is available. Following this is a discussion of fan performance and an analysis of uses. The critera and method of selection are then treated. Information on the design and testing of fans and a discussion on the flow of fluids occupies the last portion of the book.

[*"Fans" written by Theodore Baumeister, Jr., and published by McGraw-Hill Book Company, New York. Cloth-bound; 6 x 9 in.; 241 pages. Price, $3.50.*]

BUSINESS TRENDS



Air Conditioning, Automatic Heat and Building Gains Feature Business News

A CONTINUED pick-up in residential building, marked gains in air conditioning installations, and, excepting for minor set-backs now and then, a steadily progressing index of activity in the heating industry feature June and July business news.

One of the tables, covering 16 cities in addition to four boroughs of New York City, shows the trend of air conditioning. The reports are from utility companies which have cooperated in sending monthly reports on the number of installations added to their lines during July, as well as the horsepower of these installations. Where the data are available these companies have supplied data for the corresponding months in July 1934. Comparing the reports of those companies which furnished figures for July of both years, there was an increase from 1320 to 1524 installed hp., the latter figure being for July, 1935. A comparison of the figures of companies which reported for the first seven months of both years shows an increase from 15,722 in 1934 to 16,239 in 1935.

It should be noted that for Detroit the figures for July include over 1500 hp. not connected to the utility's lines, but which were installed in the Ford plant.

The other table shows the comparison of heating and ventilating equipment sales for June as compared with June of last year and with May for the present year. The latter comparison is not especially valuable since most of the equipment has a seasonal increase from May to June. This however is taken care of by correcting for the seasonal increase and making a composite of the number of items which make up HEATING AND VENTILATING's Heating Business Index shown at the bottom of the table.

The Index of Automatic Heating continues to show a sharp rise, having increased from 112.8 in May to 125.8 in June even after the seasonal correction was made. In other words, the oil burner, residential stoker, and gas boiler business is about 25% above 1929 levels.

The Index of New Building is based on F. W. Dodge figures for 37 states and is also adjusted for seasonal variations.

Improvement in the industry is reflected in stock prices of 11 typical companies engaged in the sale of heating, ventilating, piping or air conditioning products, shown in another index at the bottom of the table.

The chief item of significance in the July record is to be found in activity in the residential field, as distinguished from other classes of construction. For residential building, the July total amounted to $48,371,800; this was almost 2½ times the volume reported for July, 1934. The residential total for July slipped about 3% from the June contract volume of $49,832,600 but that is less than is customary at this season of the year.

Marked improvement in the real estate situation in nearly all parts of the country is indicated in the semi-annual survey of the market recently completed by the National Association of Real Estate Boards.

Results of the survey, which utilized data from confidential reports of member boards in 251 cities, were made public August 17. They represented "the best news for real estate in several years."

Market activity was found to have increased over last year in 81% of the cities reporting. Prices now being received were listed as higher than a year ago

(Continued on page 74)

SUMMER AIR CONDITIONING INSTALLATIONS REPORTED BY 19 UTILITIES FOR JULY 1935†

City	July 1935		July 1934		7 Months, 1935		7 Months, 1934	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Omaha	17	372	18	83	38	1439	33	228
Indianapolis	7	375	—	—	22	1450	—	—
Chicago	61	250	44	717	253	4550	203	4333
Washington	31	270¾	17	248¼	108	6372	69	8240¼
Detroit	17	188	—	—	64	2570	—	—
Toledo	8	52	—	—	18	375	—	—
Akron	0	0	0	0	8	59	8	60
Pittsburgh	23	865	—	—	69	1280	—	—
Queens	2	42	3	5¾	9	161¼	16	231¾
Manhattan and Bronx	39	580	—	—	158	6287	—	—
Rochester	9	144	—	—	19	367½	—	—
Philadelphia	16	395	14	266	115	2940	83	2040
Cincinnati	20	51¾	—	—	76	2126¼	—	—
Dallas	20	78	—	—	58	1170	—	—
Scranton	3	75	—	—	6	112	—	—
Boston	6	194	—	—	36	718	35	589½
Hartford	7	43	—	—	12	166	—	—
Brooklyn	4	1719	—	—	9	1762	—	—
New Orleans	12	48¾	—	—	32	151	—	—
Total	302	5743¼	96	1320	1110	34,056	447	15,722½
	July 1935		July 1934		6 Months, 1935		6 Months, 1934	
Baltimore*	—	—	—	—	57	1598	—	—

†Dash indicates no report available, not that no jobs were installed.

*Divided among: Public and Institutional, 1 job, 5 hp.; Theatre and Recreational, 8 jobs, 413 hp.; Residential, 9 jobs, 17 hp.; Industrial, none; Commercial, 39 jobs, 1163 hp.

EDITORIALS

Air Conditioning Moves Along

For some time we have been engaged in collecting information from the field to check up on the progress of air conditioning. The survey is not complete. Reports coming in from many cities show that air conditioning is doing well. There seems little doubt but that there is a substantial increase in total volume of business over last year. The source of the gain is also working out according to predictions, for commercial buildings are accounting for so much of the volume in the scattered returns now at hand that the final result is evident. It also seems certain that the size of the average job will again show a decided reduction. This also is in line with expectations. What may not be so well known is the huge amount of air conditioning equipment which has been installed in Federal buildings in Washington both last year and this. Appropriations to install cooling in the Senate and House office buildings are still expected. For a depression business progressing under difficulties summer air conditioning is stepping right along.

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Radiators vs. Warm Air for Residence Work

Practices in connection with the heating or cooling of homes are always of interest, for everyone has a home and the general practices are familiar as every-day experience. We all know that these practices have changed enormously over the past few years.

For years the homeowner has been able to make a choice between a radiator job or a furnace job, and could get any fuel he wanted, and a wide diversity of controls and accessories. For years, also, the tendency was for the gravity furnace to go into small homes and for radiator jobs to go into the larger ones, although the practice was not uniform, for the middle west section made large use of furnaces.

This situation was upset by the application of the power-driven fan to warm air furnaces. It permitted them to be adapted to larger residences and also permitted the use of filters. As humidifiers had long been in use the forced air furnace could claim that it fulfilled all the functions of winter air conditioning. This its sponsors were not long in capitalizing. As the price of such installations was moderate, they began to enjoy increased popularity. With air conditioning on everyone's tongue, these installations rode the popular wave for all it was worth. They began to encroach on the large residence field, which had been in possession of radiator heating, and also offered competition all along the line of residence heating.

As this has gone on the various moves made by those most concerned with radiator heating have been both interesting and confusing. Especially have they been confusing to all those contractors who pinned their faith and their business to radiator jobs. They fought back with what weapons they had, but could not seem to get in line with the popular interest in whatever bore the magic label "air conditioning." They could not claim that their radiator jobs gave artificial humidification or that the air in the house was being cleaned or continuously circulated. It is true that these operations could be performed, but equipment for doing it was not actively promoted by anyone capable of giving them real support in the way of publicity and promotion. It looked to many as if the forced-fan furnace was on the verge of capturing the house-heating field.

Now comes word that support is coming to the radiator job from powerful quarters. American Radiator has brought out a unit at a competitive price, intended to permit radiator heating to not only regain its position but to carry the fight into the small residence field as well. Moreover, the magic word "conditioning" is to be adopted and used. Thus, we are to have what amounts to "radiator conditioning." Additional help is also announced in terms of full-fledged "systems." To back up these plans and products there is to be one of the most intensive advertising and publicity campaigns ever made in connection with the sale of house-heating equipment.

It looks very much as though we are about to see the struggle for the home-heating business between radiators and furnace heat resumed on more nearly even terms than have prevailed of late years.

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New Industrial Uses of Air Conditioning

Evidence is appearing that industrial executives are looking into the possibilities of air conditioning and are finding uses for it which are off the beaten path. Formerly air conditioning in industrial plants was applied largely to those products where humidity had important effects on the quality of the product. Then offices at industrial plants here and there began to be conditioned for employee comfort. The newest applications are in metal-working p'ants where humidity is not the variable over which control is sought, but where temperature variations are to be avoided. Recent announcement of the Ford plan in this connection calls attention to this fact. In the plant of International Business Machines where the objective was largely employee comfort, the dust and oil quantities removed from the air are impressive. Results from these two widely-publicized installations are certain to attract much attention. Air conditioning seems to have the happy faculty of continually finding new and rather unexpected applications. It is quite possible that a new era of industrial usage for it may just be getting started. It may be that we will all have to modify our ideas of the volume of business which may be expected from industry as more and more new applications are found.

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FHA Policy toward Equipment

Reports from Washington indicate that a change of policy toward loans and insurance of loans by FHA is under discussion. It seems that an influential group feels that these loans ought to be made only on the construction of buildings, or at any rate that the scope of the activity of FHA ought to be greatly curtailed. It is whispered also that the loans made to date are not high class and that there will be substantial losses to be made up. Loans on equipment and accessories are the special target.

Of course there is no way for the ordinary citizen to know how good the portfolio of loans acquired to date really is. Probably even the experts are guessing to a considerab'e extent. Unless there has been an almost complete absence of judgment in passing on the loans made, there is little reason for concluding that any large number of them are going to result in losses. The whole record of this kind of financing is against such a conclusion.

Admittedly FHA lending has done a good deal to stimulate activity in our industry and in the absence of any convincing proof that the present practices are wrong, we believe that the great majority will continue to hold that the policy is all right. In fact the proof will have to be mighty convincing indeed before those who have seen business expand under the stimulus of these loans will want to see them curtailed.

NEWS OF THE MONTH

Details of Oil Burner Institute Program Announced

NEW YORK—W. J. Smith, president of the A.O.B.A. has authorized the following statements which further amplify the program of the Oil Burner Institute, as recently announced:

The new program of the Oil Burner Institute contemplates primarily the organization of every strong representative oil burner appliance interest in the country, and therefore is a corralling of influence rather than of the modest attendant funds that will come from the new memberships for furtherance of the program. Funds from present membership are sufficient to carry to a conclusion the contemplated new organization of the Institute.

The major objective of the Institute is to increase markets, through greater public acceptance of oil as a fuel for all oil burning appliances. Other collateral activities on behalf of members will be at first subordinated to this principal effort.

Studies are now being carried on by officers and membership committees with representative manufacturers in each of the contemplated new classes of membership, and exact bases of inclusion of such membership in the Institute will be adopted at an early date. Immediately thereafter invitations will be issued to all oil burning appliance manufacturers and other affiliated industries. Necessary sectional group meetings will be held to directly explain the purposes and the program of the Institute.

Designs for the O.B.I. seal of approval are being made and an announcement of the design selected will be made at an early date. The committee on technical research is completing its study on standards and specifications to be met for use of the seal on equipment and in advertising. This will be submitted to the board of directors for its decision in setting of such terms and conditions. The membership of the Institute will be aided and encouraged in properly exploiting the seal as the nationally recognized standard of approval of oil burning appliances. In a period of time this is expected to become as valuable to manufacturers in their marketing as similar symbols have proven to other industries.

An economic and market survey is being made by The Industrial Corporation of Baltimore, with whom the managing director, G. Harvey Porter, is associated. This will consider potential markets for oil burning appliances and estimate the resultant increase in demand for oil through partial or total sales of such equipment. In conjunction with this, studies will be made of publicity media to influence greater public acceptance of oil as a fuel for heating, cooking and power.

With the market surveys in hand the Institute plans to study sound methods of securing national publicity to increase sales of oil burning appliances. A number of methods of assuring this have already been reviewed and several classes of interest outside the membership would be materially benefited through such sales increases.

Company Guarantees Gas Bill

BIRMINGHAM—Guaranteed gas bills are being used by the Birmingham Gas Company to obtain the house heating market in "The Pittsburgh of the South," where wagon mine coal sells as low as $2 a ton. The company guaranteed the bills in 81 installations last year and in only four cases did it have to make any refunds.

The guarantee is to the effect that the bill for the heating season from October 15 to May 15 will not exceed the estimate made by the company engineer more than 10%. Estimates are based on the formula of the American Gas Association, plus a corrective factor found to apply to Birmingham. The estimate is based on a 2,550 degree day season for Birmingham.

The engineer in making an estimate for a house takes the average for similar houses with actual installations and adds 10%. The heating bill is then guaranteed not to exceed 10% of the figure thus derived.

Actual gas bills on home heating are checked monthly with the guaranteed estimate. If the actual bill runs more than the estimate, an engineer goes out before the owner receives the bill, and makes a check. It may be that a defect may be found in the heating or that the owner is allowing the temperature to run excessively high in the house. The estimate allows for 72° inside temperature during 16 hours of the day and 65° at night. If the engineer suspects that the owner is allowing excessive temperature, he places a meter in one of the rooms for a check. By this method the cause of excessive bills is found and remedied in the beginning instead of waiting until the end of the heating season.

The following gas heating costs in Birmingham have been found to be average by the Birmingham Gas Company:

Size of House	Annual heating bill
One story, five room.....	$ 70
One-story, six room	85
One-story, seven room	105
Two-story, seven room	115
Two-story, eight room	130

A.C. for Ford Plant

DETROIT—For the first time in history temperature regulation and air conditioning are being installed in machine shops and foundries of automobile manufacturing plants. This is being done at the Ford Motor Company's Rouge factory. The installation already includes 200,000 cu. ft. of buildings, and soon will include a further 75,000 cu. ft.

The purpose is three-fold, according to Ford officials—to control the accuracy of fine machining operations, such as cylinder lapping; to increase the comfort of the workmen, and to protect the processes from dust and dirt.

For several years the company has controlled the temperature in its gage rooms, so the accuracy of gages shall be insured. Within recent months temperature regulation has been extended to inspection rooms in various parts of the plant. A few weeks ago the cylinder lapping room was air conditioned. Installation of air conditioning in various mould rooms of the foundry is now in progress.

The importance of this innovation may be realized from the fact that the air washing apparatus which had previously been used to supply outside air to the foundry collects about 42 cu. yd. of dirt a week. This falls from the water screens into large metal pans, of which there are 14. Each of these pans fills to a depth of five or six inches in a week, the quantity per pan running about three cubic yards.

While it will be impossible to control the temperature exactly in the casting room because of the great heat radiated from the ladles of molten steel while casting is in progress, it will be possible to reduce the temperature and humidity greatly and so increase the comfort of the men.

In the cylinder lapping room temperature regulation was undertaken because there was a variation in the size of the cylinder blocks on very hot days as compared with cooler days. Because of the close fit of pistons in cylinders, this variation was enough to cause an engineering problem, which has now been eliminated. Control of the temperature of the lapping compound as it flows over the cylinder blocks is also of importance.

It is planned to extend temperature regulation to the rooms where cylinder blocks are bored out before lapping, and to rooms where crankshafts, camshafts, pistons, and flywheels are finished.

Air conditioning is now being installed in the executive and other offices of the company at Dearborn.

Gas Operated A.C. System for Washington Utility

WASHINGTON — Suitable ceremonies marked the dedication of the first gas operated silica gel air conditioning system to be installed in this city recently when the system was put into operation at the main offices and merchandise building of the Washington Gas Light Company.

M. L. Sperry, president, received a scroll on this occasion, congratulating the company upon the installation, from Lyle C. Harvey, vice-president and general sales manager of the Bryant Heater Company, manufacturer of the system.

Patrons of the local gas light company may now experience the comfort of conditioned air in the display rooms and offices of the company.

Leon Ourusoff, engineer in charge of gas utilization of the company, supervised the design and engineered the local installation of this system, with the aid of company engineers.

Lawler Associated with Harbula

WHEATON, ILL.—Matthew M. Lawler has become associated with M. G. Harbula in the latter's consulting air conditioning engineering practice here.

Mr. Lawler was graduated as a mechanical engineer from Stevens Institute of Technology in 1925, and became connected with Drying Systems, Inc., in its New York office as junior air conditioning engineer. In 1928 he became associated with the Cooling and Air Conditioning Corporation in the New York office, as air conditioning engineer, and in 1930 this company sent him to Los Angeles as their district manager. Mr. Lawler remained on the Coast until 1934. In the fall of 1934 he was made Chicago resident manager of the Hitchen Engineering Company.

One of the first projects that Mr. Lawler will be working on in Mr. Harbula's office is the complete air conditioning system for the Mellon National Bank of Pittsburgh, which is being installed at the present time.

A.C. Progresses in Denver

DENVER — The campaign launched early last spring by the Public Service Company of Colorado to educate Denver and vicinity in the advantages of air-conditioning is producing results at an increasing rate.

Contracts to install gas fired heating and humidifying systems in ten new homes were signed by the company during June and July, with a like number in prospect in August, according to Glen E. Marica, heating and ventilating engineer in charge of air conditioning.

Tax on A.C. Dealers

BIRMINGHAM—Birmingham has levied a privilege license of $150 a year on air conditioning dealers. The old code made no mention of air conditioning.

Through an oversight proper credit was not given in the article "Heating a Large Low-Cost Housing Project," in last month's issue, to the designers of this outstanding job. Harry J. Eggly, Jr., was the consulting engineer and the office of W. Pope Barney was the architect. Both are Philadelphia firms.

FHA Rule Stimulates Air Conditioning

CHICAGO—Since the extension of the amount insurable by the Federal Housing Administration under the modernization credit plan to $50,000 on commercial, residential and industrial properties, increased interest in the possibilities offered by air conditioning equipment is being reported from many sources, according to Percy Wilson, FHA regional director.

Installation of complete air conditioning equipment and ventilating system at the Parkway Theater, 2736 North Clark Street, was completed Thursday. The Air Conditioning Corporation, 221 No. La Salle Street, furnished equipment and made installations, the financing of which was made possible through an FHA insured Title I loan of $8500.

Explains Electrol's Status

NEW YORK—In response to frequent requests as to the future status of Electrol, Incorporated, Morgan J. Hammers, president of that company has announced that reorganization proceedings in the New Jersey Federal court are progressing satisfactorily and the final plan of reorganization will be submitted in the near future.

According to Mr. Hammers, under the final plan which will follow closely the preliminary plan already submitted to the Court, Petroleum Heat and Power Company will cooperate in forming a new Electrol corporation to carry on the Electrol business as a separate entity, distributing Electrol oil burning equipment through Electrol's own exclusive distributing channels and selling fuel oil through its subsidiary, Electrol Fuel Oil Corporation.

Weisselberg Moves

NEW YORK—Arnold Weisselberg, consulting engineer, has moved his office from Jersey City to 1071 Sixth Avenue, this city.

Leone Wins Prize Contest

PORTLAND, ORE.—The Iron Fireman Manufacturing Company recently completed an architectural competition in cooperation with the publication *Pencil Points* covering a design for a house for a family of five, the house to be heated with coal. Several hundred architects submitted plans and the winner was Amedeo Leone of Detroit who was given the first prize of $1000. Other prize winners were John W. Keyes, Philadelphia, second prize, $500; J. Floyd Yewell, New York, third prize, $250 and honorable mention, $50; Helmer N. Anderson and Frank Elmer Wood, Chicago, collaborated on the design which won fourth prize of $100.

Twenty-five additional prizes of $50 each were awarded for honorable mention designs. Thirty-six architects from 10 states participated.

Dwight James Baum of New York was chairman of the jury of award. Other jury members were Edward W. Donn, Washington, D. C.; Ralph W. Gray, Boston; Walter S. Frazier, Chicago; Hal F. Hentz, Atlanta; James M. Hamilton, Cleveland, and Edwin H. Hewitt, Minneapolis.

G.E. Extends Sales Program

BLOOMFIELD, N. J.—According to J. J. Donovan, manager of the air conditioning department of General Electric Company, cooperative sales arrangements which a number of G. E. air conditioning franchise dealers in various sections have worked out with heating contractors in connection with the sale of oil and gas furnaces, may now be extended generally.

While no publicity has been given to such working agreements, they are said to have proved satisfactory, and their extension now is in line with a program designed to further the pleasant relationship which has grown up between G. E. dealers and the trade. Mr. Donovan said:

"The program advanced by G. E. dealers will enable heating contractors to share in the profits on all cooperative sales of oil and gas furnaces, in addition to making installations. The contractor will have the advantage of the highly trained sales and engineering staff of the dealer to back up the work of his own sales organization, as well as the national advertising and promotion of the General Electric Company, without the necessity of carrying a stock of furnaces.

"We believe that the heating contractor will find the cooperative program a source of considerable profit, especially at this time when both new building and modernization activity are creating a wider market for the sale of modern automatic oil and gas heating systems."

New England A.C. Men Meet

SCITUATE, MASS.—Increased business, decreased prices as production is increased, and other hopeful trends in the industry were reported at the second annual outing of the Air Conditioning Bureau of New England at the Scituate Country Club August 22. More than 250 attended.

Julius Daniels, president of the Bureau, was the principal speaker.

Thomas H. Carens, assistant to the president of the New England Power Association, and Rudolph Sommers, executive vice-president of the Boston Ice Company, also spoke.

The president's cup, three-year golf trophy, was awarded to W. J. Hajek of the Minneapolis-Honeywell Company.

Assisting Mr. Daniels, chairman of the outing committee, in various capacities were Rudolph Sommers, W. D. Wilkinson, New England Power Association; D. H. Ramsay, Jr., Westinghouse Electric and Manufacturing Company; John Pfeil and L. S. Kimball, Frigidaire Company; Harry C. Mayo, Lawton Engineering Company, and Bayard Robertson and Daniel Ricker, Boston Edison company.

A.C. for Trout Pool

HARTFORD, CONN.—A. C. Gilbert, former Yale pole-vault star and sportsman has air conditioned his private trout pond by pumping air, cooled with water from a deep artesian well, through a pipe along the bottom of the pond. The cold air, rising to the surface from jets, not only cools but aerates the water, and the trout, normally sluggish during the summer heat, are much livelier.

May Revive Heating Group

TORONTO, ONT.—The matter of calling a meeting shortly to revive interest in the Ontario Society of Domestic Sanitary and Heating Engineers is being considered. It is expected that representatives will be present from centers where local societies have been formed. London, Hamilton, Ottawa and Toronto, are taking an active interest in the matter.

Central Plant Proposed

TRURO, NOVA SCOTIA—The Truro Electric Commission is considering establishing a central heating plant in the city. The plant, which will be used at the outset to heat some of the larger public buildings in Truro, is planning to charge 80 cents per 1,000 lb. for the first 20,000 lb. of steam used each month. The rate will be correspondingly lower for consumers using larger quantities of steam, until a minimum of 50 cents per 1,000 lb. is reached for users of 200,000 lb. per month. Lower rates, however, are being considered.

A.C. for Canadian Train

MONTREAL—In order to provide the acme of comfort for passengers on trains enroute from Montreal to New York City and Washington, the trains of the Canadian National Railways have been air-conditioned. Air-conditioned cars have also been placed on The Ambassador, operating between Montreal and Boston daily. It is claimed by C. W. Johnston, general passenger traffic manager of the company, that air conditioning is attracting more traffic.

Germans Condition R.R. Cars

GERMANY — Interesting experiments with new methods of air conditioning railroad cars are being conducted by the German Railroad Company.

Through funnel-like openings in the ceiling, cooled or heated air is delivered into the cars. Cooling is accomplished by contact with porcelain rings arranged as filters, which are cooled by ice water.

N. J. Utility Cools Office

ORANGE, N. J.—Installation of an air conditioning system in the Public Service office in Main St., Orange, will be started in a few days. The company is air conditioning its offices in Elizabeth, Englewood, and Camden.

The work is under the supervision of the electrical engineering department of the company. Conditioned air will be distributed to all parts of the building, including the main sales floor, through ducts.

Germans Hold H&V Congress

BERLIN, GERMANY — The Fourteenth Congress for Heating and Ventilating was held here June 26-29, with attendance from Germany and abroad. The purpose of the Congress was to promote trade and professional cooperation and to strengthen the consciousness of the public that the special technical work in the heating and ventilating field is intended to assist society in its enjoyment of life.

Papers presented before the Congress include the following: "Problems of the City of Berlin in the Field of Heating, Ventilation and Cooling"; "District Heating Establishment for the City Museums on the Museum Island in Berlin"; "Research into the Economics of Central Heating of Residential Buildings"; "Distance Heating of the Reich Sport Fields through the West Power Station of the Berlin Power & Light Company"; "Heating and Ventilation Plant of the State Opera Unter den Linden in Berlin, and Its Maintenance"; "Temperature and Humidity in Crowded Rooms"; "Air Conditioning for Industry and Comfort"; "Notes on the Installation and Operation of Ventilation Plants."

Dearborn Inn Air Conditioned

DEARBORN, MICH.—The Dearborn Inn is now 100% air conditioned. This inn, one of the 17 "Real New England Inns," has a year 'round Carrier system serving the one hundred bedrooms, ball room, dining room, coffee shop, Colonial lounge, lobby, and barber shop.

A feature of the installation is an outdoor spray pool, 50 by 90 ft., in which the water which washes and purifies the air is cooled before being returned to circulate through the hotel and by which, it is hoped, a saving of several thousand dollars annually in water bills over ordinary systems will be effected.

Fan-Furnace for Arctic School

TORONTO, ONT.—Pease Foundry Company, Ltd., recently shipped two of its largest wood-burning furnaces and two of the largest furnace-fan units, to the Anglican School in Aklavik, North West Territories. Aklavik, which is the northernmost town in Canada, is 2,000 miles north of Edmonton. Colonel Lindbergh and his wife landed there in 1931 when on their round-the-world trip by plane.

Legitimate Theater Cooled

NEW YORK—The first legitimate playhouse in New York to use a modern air conditioning system, Henry Miller's Theatre, has installed year-round air conditioning equipment that features "box office control."

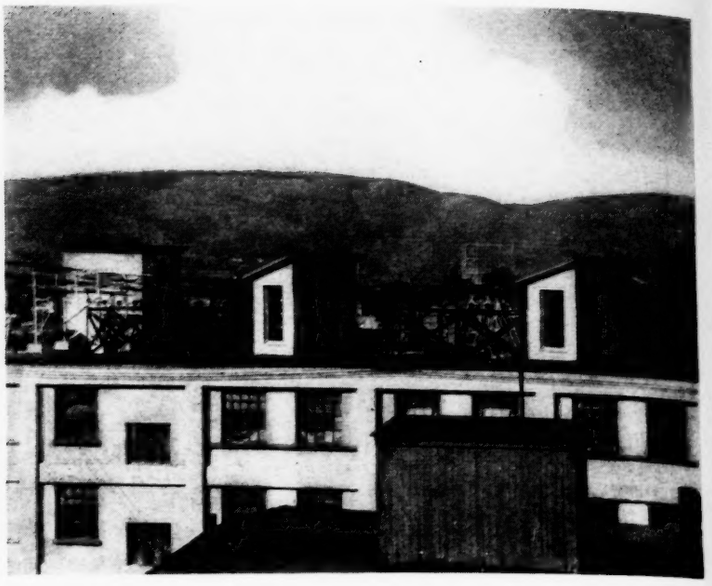
The system is operated by three 25 hp. compressors which are connected to a bank of cooling coils through which the air passes to be tempered. As the size of the audience increases one, two, or three of these may be brought into action. Airtemp equipment is used.

A.C. for New Orleans Hotel

DAYTON—Frigidaire Corporation has received from the Roosevelt Hotel, New Orleans, an order for air conditioning of 113 rooms in the hotel. Installation of a multiple air conditioning system with individual units in each of the 113 rooms is to be completed as rapidly as possible.

Rochester to Have Second Conditioned Newspaper Plant

ROCHESTER, N. Y.—The *Times-Union* Building will be the world's second completely air conditioned newspaper plant. A year-round air conditioning system now being installed will serve the entire building, including the editorial rooms, composing rooms, press room, business and advertising offices, and executive offices. The *Rochester Democrat & Chronicle* also is printed in this building.

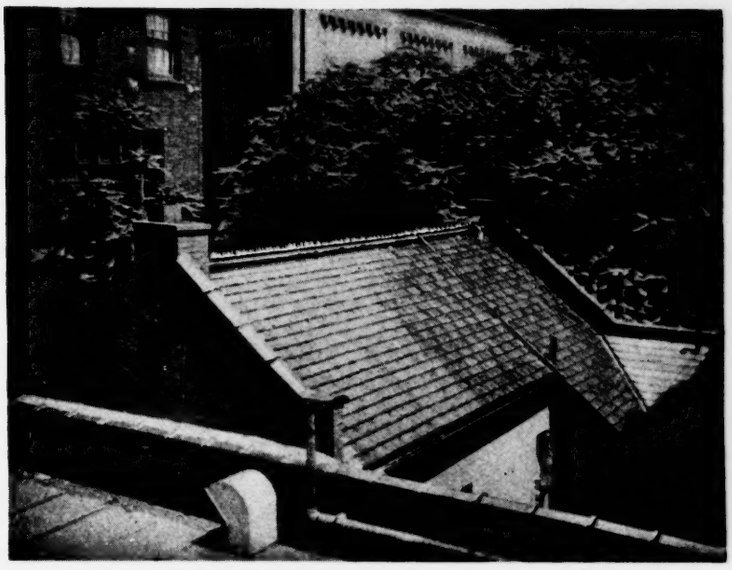


HEAT ABSORBING GLASS. These test houses were used in experiments on heat absorbing glass carried on by Physicist W. W. Shaver, at the Corning Glass Works. Glass has been developed which transmits only 42% of the sun's heat as compared with 88% for ordinary double strength window glass, thus acting as a summer insulator.

PICTURE

MISS DOLE VALVE, clad in advertising blotters, as observed at the Plumbing and Heating Exposition in Chicago, June 24-27. To those attending she distributed blotters similar to those on her dress.

STREAMLINED FUEL OIL TRUCKS of Standard Oil Company. They are of the combination type suitable either for heating oil or gasoline deliveries. The one illustrated has five compartments and a capacity of 1200 gal.



WATER COOLED ROOF. This private dwelling in New York utilizes water evaporation for maintaining a low temperature during hot summer days. A small pipe with holes every few inches runs along the ridge of the roof. Only enough water to form a thin film is used and is collected by the gutter and then flows to the sewer.

HELYN WINANS, of the Eugene P. Kiehl organization, Philadelphia, made the first sale in the Westinghouse drive on self-contained air conditioners recently. She made the sale on the basis of appearance, finish, and the fact that hardwood floors need not be torn up.

PARAGRAPHS

MODERN SMOKE STACK for new city hospital. The Queens County, N. Y., General Hospital, the first municipal hospital to be erected in that county, features a chimney arrangement of unusual design. The power plant and other buildings of the group follow the same modern design.

A federal loan was recently granted to furnish equipment for this hospital.

American Radiator Announces "Stripped Ford of A.C. Industry"; Will Sell Complete Heating Systems

CHICAGO—A preview of the Arco air conditioner held in the Boulevard Room of Hotel Stevens here on August 1 attracted over a thousand interested contractors, engineers, architects, homeowners, and civic leaders. The exhibit, under direction of Kimball Burr, sales director of air conditioning, American Radiator Company, was held to acquaint those in attendance with this newest product of Arco, described by M. J. Beirn, vice-president and general manager of American Radiator and Standard Sanitary Corporation, as "The stripped Ford of the air conditioning industry." It is intended for use in residences of the $3000 to $8000 class.

This unit, intended to be hooked into a radiator heating system to condition a six-room home without the use of ductwork, is of the ceiling-suspended type. It provides for heating the air by connection to any steam, hot water, or vapor system, for humidification through a self-cleaning nozzle spray, filtering by a renewable viscous filter of fiber board, and circulation by means of a Sirocco fan driven by a 1/20-hp. motor, together with suitable controls. Space is also provided for installing cooling coils where and if desired.

Four sets of controls are provided for use with the conditioner, thus offering varying control and a choice to fit the particular case. Control methods include manual with a switch, humidistat control, and also control of the blower to turn it off automatically when the tempering coil is not operating in winter, or any combinations of these controls. All control arrangements include a solenoid valve.

The unit exhibited weighs 130 lb., has a tempering capacity of 1200 B.t.u. per hr., and handles 500 c.f.m. Capacities of 350 and 650 c.f.m. are also available on order. It is expected that additional units of similar design soon will be available up to 3000 c.f.m.

It was announced that the unit is being placed on the market at points west of Detroit for sale in new construction work in connection with Arco heating systems, and that its sale will be extended nationally as rapidly as demand and manufacturing facilities will permit. This unit is expected to be the first step in the company's program of providing air conditioning to be sold by the radiator heating contractor. The point was emphasized at the preview that the conditioner approaches air conditioning with an integrated system using radiator heat and installed in accord with methods familiar to the radiator heating contractor. Calculations are greatly simplified as the heat load is eliminated from the air treatment.

NEW YORK — Complete heating systems built with all parts integrated, to be sold and adapted to the individual home by the established, reputable heating contractor, were introduced by the American Radiator Company on August 25.

To present the systems to the American public and give the contractor full backing in selling them, the company has inaugurated a six-figure advertising and promotional campaign which Arthur R. Herske, vice-president and general manager of sales, described as the largest concentrated campaign ever undertaken in the heating industry.

Introduction of the systems, he said, brings to a climax the company's carefully evolved policy of extending its line of equipment and accessories to permit a contractor to make a complete installation with American Radiator products and place the full responsibility for the quality of materials on one company.

It makes it possible for the company to inaugurate a definite merchandising campaign selling the complete services of the contractor-dealer to the public and is a positive response to the demand of contractors, contractor organizations, trade papers, and others, for more support by national manufacturers in contractor-dealer selling, he added.

Three radio programs, four-color advertisements in nationally syndicated newspaper sections, together with black and white advertisements in individual local newspapers have been called into play in the initial campaign.

A national contest has been started, in which a heating system with a value up to $750 will be given away every week until further notice and installed by a heating contractor named by the winner, the company paying the contractor for the installation.

Contestants, who must either own homes or be planning to build within a year, are asked to write a letter of 200 words or less on why they want an American Radiator heating system and to name the contractor that they would like to have install such a system. The name of the winner is announced each Sunday night on the company's fireside recital radio program, and the names of all other persons who write letters are returned as sales prospects to the contractor whom they name, together with a thermometer that he can present to the contestant as a special prize in making an opening contact for a sale.

As a special background for the announcement of the heating systems and the prize contest, the company arranged for three broadcasts over the WJZ network from Austria of the Salzburg Music Festival. Two broadcasts on August 11 and 18 were devoted to creating a general interest in heating equipment and in building an audience for the third on August 25 when nationwide observance of the Festival was arranged and Arturo Toscannini conducted the Vienna Philharmonic Orchestra.

At this third broadcast, the heating systems and the prize contest were announced at the same time that four-color advertisements began to appear in the newspapers. Newspaper advertising, the company's regular fireside recital on the WEAF network and spot broadcasts on local radio stations presenting Dale Carnegie in his talks on "Little Known Facts About Well Known Radio Stars," then took up the story about the contest and the heating systems.

"Now for the first time," Mr. Herske declared, "we can sell people comfort and good heating, and the contractor can have the support from us that he deserves. The radio industry doesn't sell coils, tubes, a loudspeaker, and a cabinet. They sell radios. The automobile industry doesn't sell pistons, a carburetor, seats, wheels, steering-gear, lights, tires, and a bit of an exhaust pipe. They sell automobiles.

"But in the heating industry, national manufacturers have tried to sell radiators, boilers, pipes, valves and controls, leaving the burden of assembling these things and selling a heating system entirely to heating contractors. The assembling and the installation can only be done by the contractor, but the manufacturer can aid him sell. It can furnish him with all the parts that he needs for his installation and it can help him create a demand for that installation.

"In other words we are now going to get behind the contractor and help him sell good heating and heating systems. We are going to share his responsibility, by taking the responsibility for the quality of all materials

COMING EVENTS

SEPTEMBER 30, 1935. *Fall meeting, American Welding Society, Chicago.*

OCTOBER 14-18, 1935. *Seventeenth Annual Convention of the American Gas Association, Chicago, Ill.*

OCTOBER 14-18, 1935. *Midwest Power Show, Chicago, Ill.*

JANUARY 27-30, 1936. *National Warm Air Heating and Air Conditioning Association Convention, Hotel Stevens, Chicago, Ill.*

JANUARY 27-31, 1936. *Annual meeting of the American Society of Heating and Ventilating Engineers, Palmer House, Chicago, Ill.*

JANUARY 27-31, 1936. *Fourth International Heating and Ventilating Exposition, International Amphitheatre, Chicago, Ill.*

in an installation while he takes the responsibility for the installation itself.

"We are going to back his work with national advertising and promotion to create a demand. Working together as a team, the American Radiator Company and the heating contractor are going to sell heating systems and personal comfort just as the automobile industry sells automobiles and personal transportation, the radio industry sells radios and home entertainment, and the refrigerator industry sells refrigerators and food preservation.

"We are going to make people realize what a heating system is," Mr. Herske explained, "and lift it out of the babble about gas heat, oil heat, radiator heat, cold heat, hot air heat, automatic heat, hot water heat and steam heat, that has only served to confuse the public when it was not properly defined."

WITH THE MANUFACTURERS . . . .

Bell and Gossett Co., 3000 Wallace St., Chicago, calls attention to the fact that the Chicago Master Steam Fitters Association has recently approved the use of high temperatures in mechanically circulated hot water heating systems. Hot water temperatures as high as 215° are now permissible in plans submitted to this organization. In a recently published bulletin, the association calls attention to the extreme flexibility of mechanically circulated hot water systems and points out that the systems have a wide application in the reconditioning of many inefficient water and steam systems.

A. M. Byers Company, Pittsburgh, announced its third major expansion project in recent years. Several years ago Byers completed their large and modern wrought iron mill at Ambridge, Pa., for manufacturing wrought iron under their new process. Following this, the operations were further expanded to include the reintroduction of a wide range of wrought iron products. The third step in broadening the sales and manufacturing activities of the company was taken when J. Frederic Byers, chairman of the board, announced recently that Byers steel pipe would be manufactured in addition to the present complete line of wrought iron products. It will be made in the company's pipe mills under the same supervision as exists on wrought iron pipe.

A. W. Cash Co., Third and Eldorado Sts., Decatur, Ill., has appointed Gale Engineering Co., 136 Liberty St., New York, as representative for its combustion control division. George W. Gale until recently was associated with the L. J. Wing Manufacturing Company.

Chrysler Corp., Detroit, has taken over Airtemp, Inc., as a wholly owned subsidiary. Airtemp was originally formed to market the air conditioning products of the Amplex Division of Chrysler Corporation. In the future it will both manufacture and sell Chrysler air conditioning equipment. Amplex will manufacture other equipment for Chrysler, but not air conditioning products.

B. T. Moyer is the new president of Airtemp, Inc. Other officers are: E. S. Chapman, vice-president in charge of manufacturing; A. C. Staley, vice-president in charge of engineering, and I. C. Baker, general sales manager.

H. C. Jamerson, formerly sales manager of Airtemp, will be general manager of United Air Conditioning Corporation, which, under the new arrangement, will become the organization's factory branch for the metropolitan New York area.

The Dail Steel Products Co., Lansing, Mich., has appointed the Vance-McCrea Sales Co., West 27 and Sisson Sts., Baltimore, as its representative in the state of Maryland. The company has appointed J. H. Oates, 154 South Main St., Providence, R. I., as district sales representative in that territory.

Foster Wheeler Corp., 165 Broadway, New York, announces that Harry S. Brown has been elected president of the corporation. Mr. Brown, a graduate of Cornell University, joined the Power Specialty Company in 1904, remaining with that concern for 15 years. In 1919 he became vice-president of the Wheeler Condenser and Engineering Company, and later was made vice-president in charge of sales and a director of the Foster Wheeler Corporation.

The Insulite Co., Minneapolis, Minn., has appointed A. D. Stone, Jr., assistant eastern district manager with offices at 101 Park Ave., New York.

Kelvinator Corp., Detroit, has appointed S. C. Mitchell director of advertising and sales promotion of air conditioning equipment and oil burners. Mr. Mitchell was formerly advertising manager of Leonard Refrigerator Company. He succeeds Vance C. Woodcox, who has resigned to accept an executive position with Montgomery Ward & Company.

Godfrey Strelinger, who has served with Kelvinator for many years in varied capacities, has been appointed general assistant to the vice-president in charge of sales. He comes to his new position from the sales managership of Leonard Refrigerator Company, to which position he was promoted from the managership of the Kelvinator Detroit branch.

The Kennedy Valve Mfg. Co., Elmira, N. Y. has appointed O. R. Lane as its representative in Oklahoma, Arkansas, Tennessee, Eastern Missouri, Southern Illinois and Indiana, with headquarters at 455 Paul Brown Building, St. Louis.

Jas. P. Marsh Corporation, 2073 Southport Avenue, Chicago, Ill., has appointed C. M. O'Brien as a member of its Chicago sales organization. He will contact engineers and architects. Mr. O'Brien formerly traveled the St. Louis territory for Standard Sanitary Manufacturing Company.

National Radiator Corporation, Johnstown, Pa., announces the appointment of six district managers and one special representative to the sales staff of its oil heating division. A. T. McGuire will supervise the sales of the company's steel oil boilers in Western New England, maintaining headquarters at Holyoke. Leo R. Cavanaugh, of Milton, Mass., will supervise sales in Eastern new England. Metropolitan New York area will be covered by Roy Richardson, of St. Albans, L. I., and H. E. DeLamater, of So. Orange, N. J. In Baltimore, Md., Donald Hogarth, of Baltimore, will cover the southern territory. Beverly H. Miles, of Oskaloosa, Iowa, will cover the middle-western territory. E. Ravenel Spring will cover the Philadelphia, Southern New Jersey and Delaware territory.

B. H. Baker will serve as a special representative of the company's oil heating division, operating out of the division's sales headquarters at 101 Park Avenue, New York.

Shallcross Controls, Inc., 3707 North Richards St., Milwaukee, Wis., has appointed the following organizations to represent it in the sale of its automatic controls: General Instruments & Controls Co., 205 West Wacker Drive, Chicago; W. O. Taylor & Co., Ltd., Canada Cement Bldg., Montreal; Kennedy B. Whitley, 332 West 7 St., Erie, Pa.; Walter V. Gearhart Co., Volunteer Bldg., Atlanta, Ga.; Morrissey-Kantenberger Co., Allen Bldg., Dallas, Tex.; P. C. Heckmann Co., 514 Main St., Cincinnati; James F. Strachen, 1014 Oxford St., Berkeley, Calif.; J. R. Fortune & Son Co., 604 Fisher Bldg., Detroit.

H. A. Thrush & Co., Peru, Ind., has appointed Campbell-Elsey & Company, 412 Ness Building, Salt Lake City, Utah, as its representative in Utah and Southern Idaho.

Trane Co., La Crosse, Wis., announces that Clinton H. Quirk, for many years connected with the Vento division of American Radiator Company, has joined the Trane staff. Mr. Quirk will be active throughout the Eastern territory, the same which he has contacted for a great number of years in his former capacity.

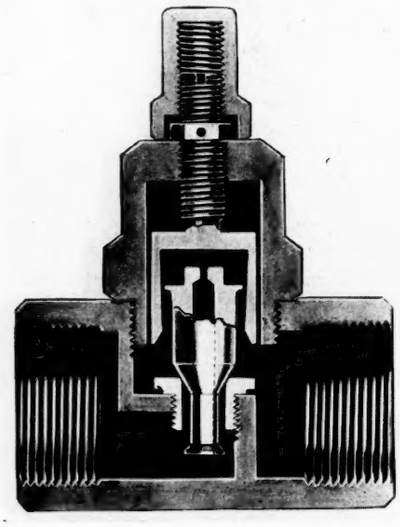
NEW EQUIPMENT

Yarway Steam Trap

Yarnall-Waring Co., Chestnut Hill, Philadelphia, has announceed an unusual steam trap, known as the Yarway impulse steam trap. It is made in six sizes, ½ in. to 2 in., and is little larger than a pipe union, the ½ in. size illustrated weighing only 1⅛ lb. The body is made of cold rolled steel, the working parts of hard monel, bonnet and cap of brass.

The trap depends for its operation on the difference in flow characteristics of cold water, hot water and live steam, flowing through two orifices with a chamber between. There is one moving part. the valve disc. Movement of this valve-disc is governed by variations in pressure in the space above valve piston called the control chamber. These changes in pressure occurring with changes in temperature of condensate ranging from cold water to water at steam temperature.

When handling cold water, the pressure under valve piston (inlet side of trap) is greater than the reduced pressure in the control chamber above piston. The clearance between the piston and cylinder acts as the first orifice, and the valve opens to allow free discharge of condensate. As the accumulation of cold condensate disappears the remaining condensate approaches steam temperature, flashing takes place in the control orifice in the center of the valve disc, the flow is choked and the pressure in the control chamber builds up to close the valve. Valve disc, piston and center orifice are proportioned to give positive opening of valve when cold condensate collects and quick closing when the pipe system is hot and there is no condensate or when the condensate is at or near steam temperature.



Yarway steam trap

Kathabar Dehumidifier

Surface Combustion Corporation, Toledo, Ohio, has placed on the market a direct, dehydrating air conditioning unit designated as the Kathabar. The name is derived from the Greek term meaning "healthy air." This system, of the gas operated summer type, uses a liquid adsorber named Kathene (lithium chloride). It was designed by Dr. F. R. Bichowsky.

Kathene is a stable, non-corrosive, non-caustic solution with which it is possible to dry air down to 12% relative humidity with Kathene A, and with even lower humidities with other members of the Kathene group.

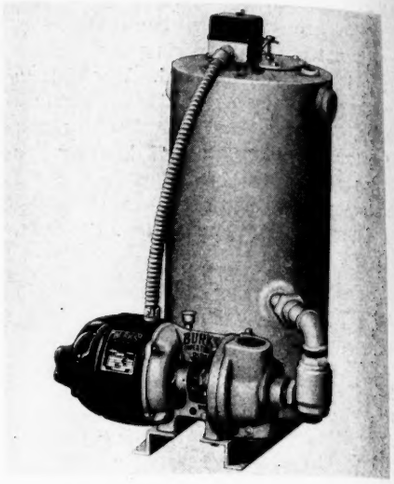
In this system the air is washed with Kathene, dried and simultaneously heated and cooled in an air washer. The washer or contacting tower may be of various types. In the standard units, the tower is of the packed type, air entering at the bottom and passing upward. Kathene collecting in the bottom of the tower is pumped through a specially designed cooler to the top of the tower where it meets the upcoming air, cools, dries and washes it. Automatic regeneration of the liquid by means of gas heat is provided, making the unit of the continuous operating type. The outcoming air always has the same properties. There is no change in direction of air flow at any time.

Kathene liquid may be regenerated in a number of ways. In the standard apparatus, a portion of the Kathene circulating through a pump is heated in an ordinary side arm gas water heater to near the boiling point and the water is evaporated off in an air stream in the small auxiliary regenerator tower. Gas is turned on only when the liquid needs regeneration and the gas consumed is proportional to the amount of water being removed from the air being conditioned.

In the small unit the air stream used for regeneration is bled off the main circulating stream. This makes possible a simple unit which has but three moving parts: a standard motor, pump and fan. An advantage of redrawing air for regeneration from the main stream is that by so doing a regular supply of fresh air is automatically drawn into the air conditioned space. The larger unit has a separate fan for the regenerator circuit.

Because of the reported high thermal efficiency of the unit, it is said to be possible to use the system in all classes of air conditioning or industrial drying problems, particularly those where the drying must be done at low temperature.

Standard units are available in four sizes: 500, 1,000, 2,000, and 4,000 c.f.m.



Burks condensate return unit

Burks Small Capacity Condensate Return Units

The Decatur Pump Co., Decatur, Ill., has announced a small capacity Burks condensation return unit for small steam plant owners. The device is automatically self-priming. The company's superturbine pump is directly mounted to a 1/6-hp. motor and this unit is mounted on the same base as a 12-gal. tank.

It is claimed that the pump will handle either air or water or a mixture of the two at high pressure. The operating pressures are up to 40 lb. per sq. in.

The tank is of copper bearing steel, no. 12 gage, 14 in. in diameter, and 22 in. high. The shaft is of stainless steel carried in oversize ball bearings, while the impeller and raceway are of cast bronze. The automatic controller switch is mounted on top of a tank and directly connected with the copper ball float within the tank. This float switch governs the operation of the motor and also provides overload protection for the motor.

The units are available in three models with capacities ranging from 1000 to 3000 sq. ft. of steam radiator.

Daycoil Oil-Proof V-Belt

An oil-proof V-belt for general industrial use has been announced by The Dayton Rubber Manufacturing Company, Dayton, Ohio. The new belt will be marketed under the name Daycoil.

The Daycoil carries the same laminated construction principles as the regular Dayton Cog-Belts for general transmission applications plus a specially designed casing of a new synthetic compound to resist oil.

(Continued on page 68)

EVERY PLACE THAT COPPER GOES USE ARCO *Copper* FITTINGS

LEAKPROOF • VIBRATION PROOF

For Every Heating and Air Conditioning Installation

WHEN you talk copper to a customer, talk *copper all the way* —at the joints as well as in the pipe. Sell a job that's *all copper* . . . with Arco Full Flow Fittings.

Arco Fittings are pure wrought copper like the pipe they join. They cannot rust, resist corrosion, are absolutely non-porous to liquid or gas. Joined to Arco Copper Pipe, they make a bond that's stronger than the pipe itself—leakproof, breakproof and proof against vibration.

The *copper to copper* connection is quicker and easier than any other type. You make it on the job, without complicated pipe fitting. It is made at a lower temperature, eliminating the chance of annealing or crystallizing the pipe waiting for the fitting to heat. And there's no chance of electrolytic action, for both your pipe and fitting are pure wrought copper.

You'll find the line of Arco Full Flow Fittings a profitable one to use. It cuts your stock inventory—you carry only a small number of basic fittings and adapters. It saves time. And it makes it possible to compete with ordinary rustable installations on a price basis and come out on top. Ask your jobber—or write to

Copper Pipe and Fittings Division
AMERICAN RADIATOR COMPANY
Division of American Radiator & Standard Sanitary Corporation
40 West 40th Street, New York, N. Y.

THE ONLY ONE OF ITS KIND

This is the famous Arco Tee. It is one seamless piece of copper, 99.9% pure. It is *wrought*, not cast, by a secret process. It is easy to handle, saves time and money. It's the only one of its kind!

ARCO
Full Flow
WROUGHT COPPER FITTINGS AND COPPER PIPE

SOMETHING NEW HAS HAPPENED TO HEATING, TOO!
FROM NOW ON, YOU CAN BUY HEATING IN ONE COMPLETE SCIENTIFICALLY INSTALLED SYSTEM AND GET ALL 3 ESSENTIALS TO MODERN COMFORT
And
free $750* prize
AN AMERICAN RADIATOR HEATING SYSTEM UP TO THE VALUE OF $750* GIVEN AWAY EACH WEEK UNTIL FURTHER NOTICE . . .
Just write a letter on the subject— "Why I want an American Radiator Heating System"
● To introduce the New AMERICAN RADIATOR HEATING SYSTEM to home owners we will give away absolutely free each week until further notice, one completely installed system up to the value of $750.*
FIRST AWARD SEPT. 8th
The first award will be announced Sunday night, September 8th over the WEAF-NBC Red Network at 7:30 p.m. E.D.S.T. Entries for the first week's prize must be received by noon, Thursday, September 5th.
*The $750. American Radiator Heating System is suitable for even large homes. An adequate American Radiator Heating System for smaller homes can be installed for considerably less than half that.
NOTHING TO BUY • NO ENTRY BLANK • NO DEALER TO SEE • NO RED TAPE OF ANY KIND
READ THESE EASY RULES
1 This contest is open to every home owner or owner-planning to build within one year except employees of American Radiator Company, their advertising agents, and their families.
2 Write a letter of 200 words or less on the subject, "Why I Want An American Radiator Heating System." Sign it with your name and address.
3 Letters will be judged solely on their sincerity and interest. Literary elegance is of no value. Just write simply in ordinary every day language.
4 Mail your letter to the Contest Editor, American Radiator Company, 40 West 40th Street, New York, N. Y.
5 Your letter must be in the offices of American Radiator Company, 40 West 40th Street, New York, N. Y., before 12 noon Thursday to be eligible for the prize the next week. Letters received after this time are automatically entered for the following week's prize. Only one letter from each home owner will be eligible for the prize.
6 The decisions of the judges will be final. In case of a tie duplicate prizes will be awarded.
7 All letters submitted become the property of American Radiator Company.
NOTE: If possible give the name of the Heating Contractor you would want to make the installation in case you win.
Special Prize for Everyone
New AMERICAN RADIATOR Heating Systems
Radiator Heat—An adequate, properly licensed source of health-ful heat in each room.
Inexpensive Domestic Hot Water—plentiful hot water for bathing, laundry and housework.
IT MEANS A N
DOM FOR YOUR HOME!
AMERICAN RADIATOR COMPANY
40 WEST 40TH STREET, NEW YORK, N. Y.

● Advertisements like this will appear in four colors in AMERICAN WEEKLY and THIS WEEK, reaching nearly 10 million circulation. Smaller ads in black and white will appear in these same publications and in local newspapers. Millions will hear the story over the radio through the weekly broadcast at 7:30 p.m., E.D.S.T., over the NBC-WEAF chain each Sunday night, and through broadcasts from local stations every week day. Cash-in on this campaign—sell American Radiator Heating Systems!

This New Merchandising Idea Will Not Only Bring Customers to You

BUT THESE CUSTOMERS WILL TELL WHY THEY WANT AN AMERICAN RADIATOR HEATING SYSTEM . . .

Every contestant will write a letter telling exactly why he wants what you have to sell—an American Radiator Heating System. You get prospects who tell you what they want to be sold.

Something New Has Happened for Heating Contractors, too!

Heating Systems

NOW WE'RE BACKING YOU TO SELL THE JOB THE WAY YOU LAY IT OUT—AS A COMPLETE HEATING SYSTEM

TODAY, millions of home owners are reading about American Radiator Heating Systems in smashing four-color advertisements in AMERICAN WEEKLY and THIS WEEK, and in dominant black and white advertisements in these same publications and in leading newspapers. Millions will hear this same story over the nation-wide radio broadcast and in programs broadcast by local stations six days a week. America is being aroused to the fact that there is something new in heating. This means something new for you, too, for at last the public, the Heating Contractor, the Wholesaler, and the Manufacturer will *all* be talking the same language—American Radiator Heating Systems.

Instead of selling boilers, radiators, valves and controls, now you can sell with the backing of all this advertising, the complete installation just as you always have laid it out, in a complete unit—an American Radiator Heating System. Your customers want to buy heating just as they buy automobiles, radios, refrigerators—in one complete

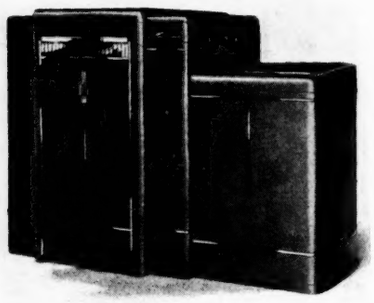
your customers will be talking American Radiator Heating Systems.

You can sell exactly the kind of system the home owner requires to suit himself, the individual room, the individual house, even the individual pocketbook. With the wide variety of American Radiator boilers, radiators, valves and controls, you can meet any demand for a complete American Radiator Heating System, designed and installed by you, with every component part backed by one manufacturer.

Write today for the free kit of sales tools to make this campaign your own local campaign. Take advantage of the opportunity we are creating for you to sell heating the way you lay it out—as one complete system. Send for your selling kit now!

AMERICAN RADIATOR COMPANY

40 West 40th Street, New York, N. Y.



Sunbeam oil burning air conditioner

Sunbeam Oil Burning Conditioner

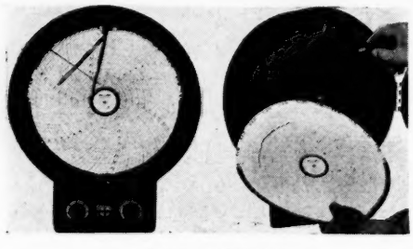
A new Sunbeam oil burning air conditioning unit is being manufactured by The Fox Furnace Co., Elyria, Ohio, division of American Radiator & Standard Sanitary Corp. The designers placed special stress on attractive appearance. The finish is smooth green enamel baked on a cabinet of heavy, furniture stock with chromium plated trimming. Corners are rounded and bolts and screws are concealed.

The unit is designed for oil burning exclusively. In one model the burner connects to the front of the heating element, where it is concealed by the door of the cabinet. In a second model, the burner connects to the rear of the heating element.

Brown Air Operated Controllers

On its 75th anniversary, The Brown Instrument Co., Wayne and Roberts Ave., Philadelphia, announces a complete line of recording and indicating air operated controllers for temperature, flow, pressure and liquid level. Among these is the Air-o-Line, a controller with 1% to 150% throttling range and automatic reset. This control system recognizes and corrects for the magnitude, rate and direction of departure from the control point. These instruments are capable of full automatic control and are said to maintain a process at the control point within extremely close limits.

Indicating and recording thermometer-type temperature controllers are available for temperatures within limits of — 40° and + 1200°. Potentiometer-type controllers are available for temperatures within — 300° and + 3400°.



Brown Air-o-Line

Two types of flow controllers and liquid level controllers are also offered —the inductance bridge type and the mechanical type. Indicating and recording pressure controllers are available in ranges from 30 in. vacuum to 3000 lb. per sq. in. pressure.

Self-Vulc Rubberizing

A rubber in liquid form, and a rubber in plastic form, are being offered by the Self-Vulcanizing Rubber Co., Inc., Room 515F, 605 West Washington Blvd., Chicago.

The products are designed to protect inside and outside surfaces against abrasion, corrosion, or acids; to restore surfaces of material which have been worn away; to waterproof or corrosionproof all kinds of containers and surfaces; to silence noises, and other purposes.

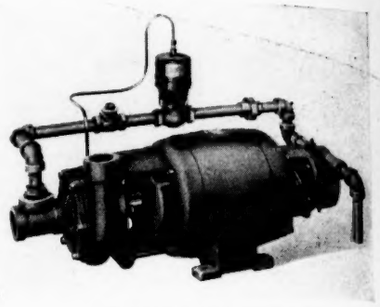
Kellogg Annunciators

Kellogg Switchboard & Supply Co., Chicago, is marketing a line of annunciator units for detecting and indicating abnormal conditions of plant operation. They are adapted for showing changes in pressures, liquid levels, speed, voltage, temperature, flow, vibration, and other conditions.

The annunciator is a signalling or recording device which acts as a check on operation. Signal lamps can be arranged to operate from continuous contacts such as those occurring as a result of a rising liquid level or temperature change, or they can operate from momentary contact such as might occur in the case of a circuit breaker or other transient phenomena.

In designing these units, practically any desired operation of indicating lights may be worked, such as a lighted condition for normal operation, a dark indication for abnormal operation, or vice versa. Two or more lights may be assigned to indicate two or more conditions and a third light to indicate change from one condition to another. The lights may remain burning so long as the faulty condition exists or may be so designed that they can be extinguished and caused to reappear by a repetition of the observed condition.

Annunciators may be operated from photo-cells and will monitor the operation of other equipment which is photocell controlled. Automatic counters may also be furnished to indicate the number of times that any particular lamp is lighted, thus providing a record of the frequency with which the observed condition occurs within a given period. Also, alarm bells may be made to ring continuously so long as the condition prevails, and may be silenced manually or automatically until again sounded by a repetition, reversal, or still another change in conditions under the supervision of the annunciator system.



Self-priming pump

Worthington Self-Priming Centrifugal Pump

A pump that will prime itself when necessary has been placed on the market by Worthington Pump and Machinery Corp., Harrison, N. J.

The pump is equipped with the Hytor, a positive primer, placed on the same shaft with the motor and pump. The only requirement is a reasonably tight suction line. When the pump is primed, a pressure-operated cutout automatically unloads the Hytor. There is no recirculation of water. There are no floats or valves to set.

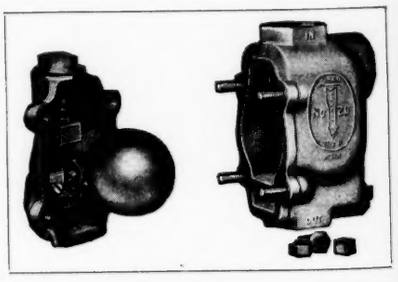
Adsco Vertical Steam Trap

American District Steam Company, North Tonawanda, N. Y., is placing on the market a combination float and thermostatic type steam trap. The entire working mechanism is mounted on the cover, with all piping connections on the body. The cover and working mechanism may be removed for inspection and cleaning without disturbing the piping connections.

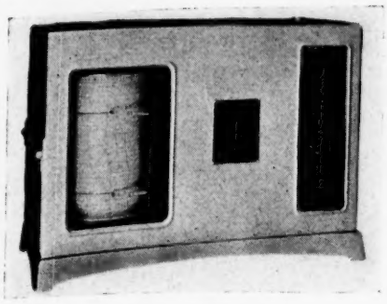
Other features are reversible valve and seat, made of stainless alloy steel. If the valve and seat show signs of wear, they can be reversed in a short time.

The trap is of the continuous flow type. It is furnished in six capacities for given pressures. Two of the models are arranged for either vertical or 90° inlet connections, while the third is provided for horizontal inlet and outlet connections from either side.

The smallest trap, weighing five pounds, is adapted for installation with concealed and indirect radiation. It fits within the small recess allotted to invisible radiation.



Adsco combination trap



Hythergraph

Friez Hythergraph

Julien P. Friez & Sons, Inc., Baltimore, Md., announces the Friez Hythergraph. This instrument follows the general lines of the company's Hygro-Thermograph, but details have been modified, and a commercial finish given whereby the instrument can be offered at a more moderate price.

Simultaneous records of relative humidity by means of multiple human hair element, and of dry bulb temperature by means of a bimetallic element, are given on common time lines.

The instrument is offered for weekly records, an eight-day clock being provided. A progressive record is given on a rectangular chart. It has been designed primarily for permanent installation in connection with air conditioning installations.

Lawler-Kelly Control Valves

John G. Kelly, Inc., 210 East 45th Street, New York, N. Y., is marketing a line of Lawler-Kelly control valves. One of these, the Weather-Matic, is a valve assembled in a 4 in. cross which is installed on the main outlet of the boiler. One side opening is connected to the supply mains and the other is piped back to the main common return, providing a by-pass around the boiler. During the heating season the boiler water is maintained at a constant temperature of 170° to 180° by an aquastat controlling the oil or gas burner or stoker. Lower boiler temperatures may be maintained during the summer months.

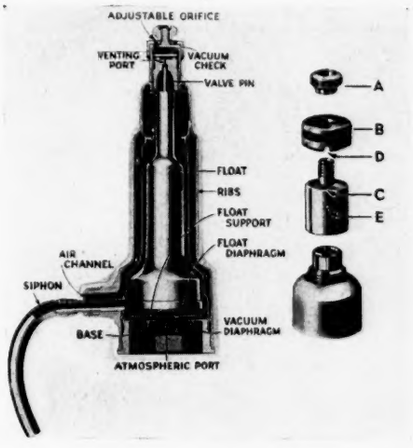
When shipped, the valve is set to tightly close the boiler outlet at an indoor temperature of 65° F. As it falls below this, the valve opens, the valve travel being proportional to the decrease in outside temperature. In this way the quantity of hot water liberated from the boiler is controlled to provide the correct radiator temperature.

When, due to low outside temperatures, the return water temperature rises, a compensating coil thermostat, located in the 4 in. cross, starts to expand and reduce the valve travel, throttling the boiler outlet to maintain the correct temperature of the mixture.

Adjustable Port Venting Valves

Hoffman Specialty Co., Inc., Waterbury, Conn., announces a new six-speed adjustable venting port, to be incorporated in all the company's air and vacuum radiator valves. This feature permits varying the speed of venting and enables the installer to balance steam circulation to radiators of one-pipe steam heating systems.

This means of control is said to be especially valuable in a one-pipe steam system with oil or gas-fired boilers. The venting of the radiators in the room where the thermostat is located can be retarded and the venting of the more remote radiators accelerated to insure their receiving their



Section of adjustable valve, with magnified parts shown at right

quota of steam during each period of burner operation.

As shown in the illustration, the top cap is a shutter containing six ports of varying sizes, which permit a wide range of venting capacity. The ports are visible and the contractor can quickly select and set the desired port. Adjustment is as follows:

Loosen knurled nut (A) on top of valve, lift and turn cap (B) until the desired port is directly above the radiator tapping. This permits desired port to register with stationary port (C) and notch (D) to engage with nib (E) when cap is lowered. Before tightening nut (A), make certain notch (D) and nib (E) are in engagement.

These ports are now furnished as regular equipment on the Nos. 2, 77 and 78 vacuum valves and on the Nos. 1, 70 and 71 air valves.

Emerson Furnace Blower

The Emerson Electric Mfg. Co., St. Louis, Mo., has introduced a direct-drive furnace blower designated as the no. 14 package unit. This is a complete blower and filter outfit ready for installation. It has a two-speed motor with resilient rubber mounting and Dustop air filter.

Oster-Williams Pipe Cutting Machine

Oster-Williams, Cleveland, has introduced a cutting machine which duplicates in design any pattern which is required for pipe welding jobs without using any cams, templates or special fixtures, and it is claimed that the finished surface has the appearance of a lathe tool cut.

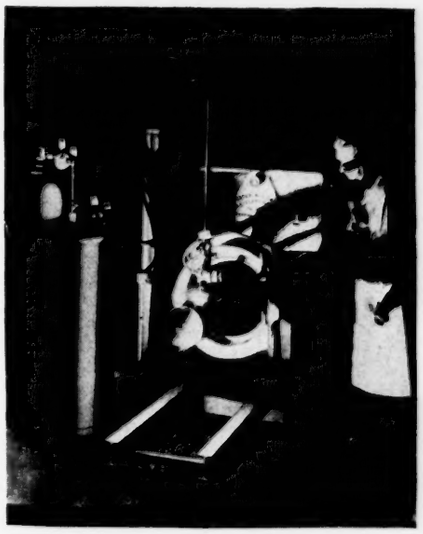
The cutting torch is guided by mechanism which duplicates the motion of a torch held in the operator's hand. It will cut pipe from 2½ to 12 in., making tees, reducing tees 90°, branch reducing tees 45° to 90°, elbow, miters, Y's and blunt bull plugs, as well as hole cutting.

The machine is somewhat similar in appearance to a radial drill press. The generating case is mounted on a rotating column which can be swung in any direction and positioned to the end or side of the pipe for the various cuts. The pipe is placed on ball bearing rollers, housed in adjustable supports.

If the end of the pipe is to be cut off for butt or tee welding, then the pipe is placed through the aluminum torch carrier ring. If a hole is to be cut in the side of the pipe, the torch carrier ring is swung around until it faces the side of the pipe. A chart is furnished which guides the operator for any kind of a job he wants, the machine is set and it is ready to make the cut.

The settings are regulated by positioning a rotating beam or lever which operates a reciprocating slide. This slide in turn controls the movement of an oscillating lever. This lever reproduces a reciprocating movement in the torch carrier. The method of imparting movement to the rotating lever is through a hand wheel, located at the side of the generating mechanism case, which also produces the drive for rotating the torch carrier ring around the pipe.

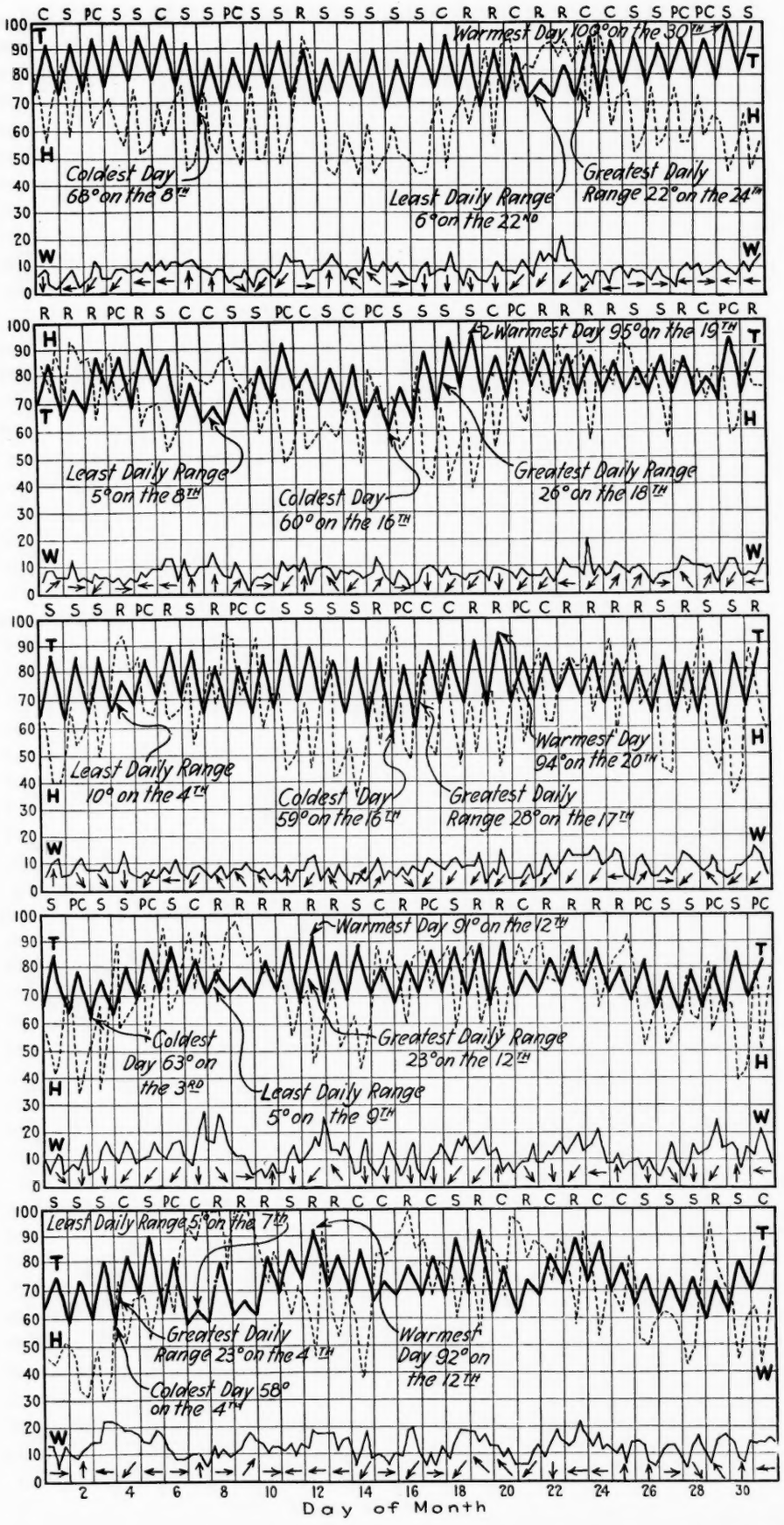
The operating hand wheel is located in a convenient position.



Oster-Williams pipe-cutting machine

THE WEATHER FOR JULY, 1935

Plotted from records compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Warmest Day 100° on the 30TH
Coldest Day 68° on the 8TH
Least Daily Range 6° on the 22ND
Greatest Daily Range 22° on the 24TH
Warmest Day 95° on the 19TH
Least Daily Range 5° on the 8TH
Coldest Day 60° on the 16TH
Greatest Daily Range 26° on the 18TH
Least Daily Range 10° on the 4TH
Coldest Day 59° on the 16TH
Warmest Day 94° on the 20TH
Greatest Daily Range 28° on the 17TH
Warmest Day 91° on the 12TH
Coldest Day 63° on the 3RD
Least Daily Range 5° on the 9TH
Greatest Daily Range 23° on the 12TH
Least Daily Range 5° on the 7TH
Greatest Daily Range 23° on the 4TH
Coldest Day 58° on the 4TH
Warmest Day 92° on the 12TH
Day of Month

St. Louis

Mean temp. for month, 82.2°; aver. wind velocity, 8.7 m.p.h.; prevailing direction of wind, SW.

Chicago

Mean temp. for month, 76.8°; aver. wind velocity, 8.0 m.p.h.; prevailing direction of wind, SW.

Pittsburgh

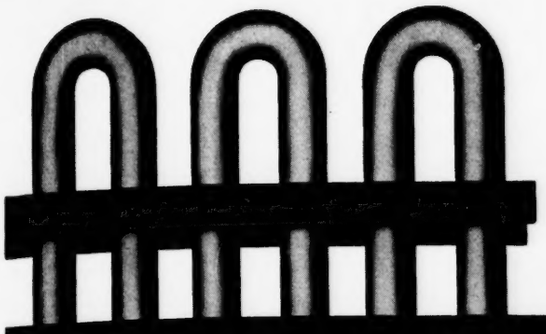
Mean temp. for month, 76.0°; aver. wind velocity, 8.2 m.p.h.; prevailing direction of wind, SW.

New York

Mean temp. for month, 76.2°; aver. wind velocity, 12.1 m.p.h.; prevailing direction of wind, SW.

Boston

Mean temp. for month, 72.6°; aver. wind velocity, 12.6 m.p.h.; prevailing direction of wind, W.



SOUND AND DEPENDABLE PIPE

IS REQUIRED *for* COOLING COILS-

be sure to specify

NATIONAL PIPE FOR AMMONIA PURPOSES

In modern ventilating and air conditioning systems, the pipe used for cooling coils must be sound and dependable. NATIONAL PIPE FOR AMMONIA PURPOSES is increasingly preferred for such installations. It is a specially made, specially tested material that promises long, efficient, uninterrupted service. In the coiling and bending operations, loss of time, labor and material is reduced to a minimum; and when the installation is complete a sound, tight, workmanlike job is assured by the use of NATIONAL PIPE FOR AMMONIA PURPOSES. The skill, experience, facilities, and organization of the largest manufacturer of tubular products in the world are represented in this superior pipe. Approval of ice machine manufacturers, consulting engineers, and heating and ventilating specialists the country over has made it—

America's Preferred Pipe for Ammonia Purposes

NATIONAL TUBE COMPANY – Pittsburgh, Pa.

Pacific Coast Distributors—COLUMBIA STEEL COMPANY, San Francisco, Calif.

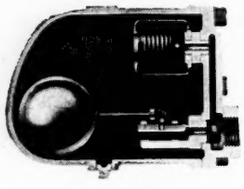
Export Distributors—UNITED STATES STEEL PRODUCTS CO., New York, N. Y.

United States Steel Corporation Subsidiary

Jewish Memorial Hospital Installs SARCO HEATING SYSTEM

TEMPERATURE REGULATOR

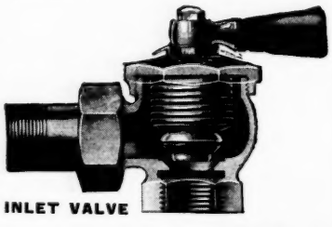
The heating equipment of a hospital must be absolutely dependable. No chances can be taken where the welfare and possibly the lives of patients may be jeopardized by insufficient heat. That is why Charles B. Myers, Architect, chose Sarco for the $1,250,000 new New York hospital illustrated.



FLOAT and THERMOSTATIC TRAP

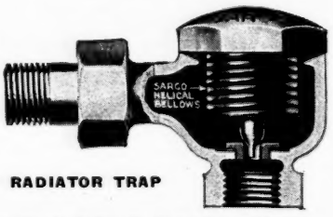
Sarco heating specialties are the result of nearly a quarter century of experience. Hundreds of thousands are in use.

Their use assures vacuum or vapor heating systems of utmost simplicity, high efficiency and trouble-free operation.



INLET VALVE

We believe you would find much interesting information in our Catalog P-45. Why not write for a copy?



RADIATOR TRAP

The SARCO COMPANY, Inc.
183 Madison Ave. New York, N. Y.
Branches in Principal Cities
SARCO CANADA LIMITED
Federal Building, Toronto, Ontario, Canada

Air Conditioned Mapparium Latest Contribution to Geography

(Concluded from page 30)

approximately 22 statute miles to the inch, and that each interval between the bronze longitudinal lines represents 692 miles. The North Pole is indicated by a star at the exact center of the top, with a light shining through it. The South Pole is similarly indicated directly below the visitor as he stands on the glass bridge. The international date line is shown in a black and white cord extending from north to south. A window cut in one side enables visitors to view a large part of the map without going inside.

Illumination of the Mapparium is achieved by some 300 electric light bulbs around its outside, the light of which is reflected against the white painted walls of the room where it is housed and an even light thrown back through the glass globe.

The entire building containing the exhibit is air conditioned. However, special ducts had to be installed to carry the conditioned air to the interior of the globe. The air comes in through intakes at the bottom, near the South Pole, flows up around the sphere and out through an opening above the North Pole.

Air conditioning in the globe is necessary to provide comfortable conditions for the visitors and to keep the glass at an even temperature. Since the lights are the principal source of heat, a special control is provided which prevents the air conditioning system being shut off while the lights are on. Thus the chance of overheating the glass through forgetfulness on the part of an employe in not turning off the lights is avoided.

In laying out this mapparium, the world's greatest authorities were consulted to secure exact data on the characteristics of the earth's surface.

Detailed Data on Urban Home Heating Systems

(Concluded from page 38)

of the four tables for a given state always equals 100%.

Table A summarizes the information for the United States as a whole (excluding the city of New York) in both total numbers and per cent. This furnishes the estimate that in numbers 75% of the country's urban residential buildings are single-family houses; 15.6% are double-family houses; and 1.2% are three or more family houses or apartments, leaving 8.2% for hotels, clubs, lodging houses, and other residential buildings. Of these urban residential buildings, 39.4% are heated by warm air, 8% by steam or vapor, 6.4% by hot water, leaving the rather amazing total of 46.2% heated either by stoves or by no heat whatever.

None of the tables, including the United States total, include the city of New York. A Real Property Inventory was conducted in this city but information had never been tabulated as to the type of central heating employed, the figures being confined to whether the building had central heat or not. The following table shows the number of residential buildings in the five boroughs of the city of New York:

Single-family houses	303,892
Two-family houses	160,457
Non-elevator tenements	127,451
Hotels and elevator apartments	5,735
TOTAL	597,535

There is no indication whatever as to the distribution of heating systems in these buildings. The majority of the single-family houses are in Queens which is primarily a family residential district, while most of the two-family houses are in Kings County (Brooklyn). Kings County also leads with the non-elevator tenements, whereas hotels and elevator apartments are largely concentrated in Manhattan. Beyond the fact that undoubtedly practically all of the elevator and hotel apartments are heated by steam no conclusions can be drawn regarding this city. Even information as to whether the buildings have central heat or not is difficult to obtain because the data have been tabulated on the basis of dwelling units rather than structures. In Manhattan, for example, out of 582,804 families covered by the census, 157,749 are without central heat.

Safe Piping Jobs Aim of New Standards

(Concluded from page 52)

ground piping which is to be buried or otherwise made inaccessible, the assembled lines shall first be tested hydrostatically at a pressure of one and one-half times the maximum allowable service pressure and held for a period of at least two hours without evidence of leakage. Where a hydrostatic test is impracticable, the piping shall be similarly tested with steam at a pressure at least equal to the pressure at which the piping is to be operated. These tests may be made on sections, or the whole of the piping system, but the connections between the sections must be similarly tested. Welded underground piping shall be given a hydrostatic test of one and a half times the maximum service pressure.

Even though pipe reaches the user in nominal sizes which carry an average wall thickness as given in the widely used pipe dimension tables, this code sets up a formula for computing the safe wall thickness of pipe. The formula set up is one of longstanding form but values are assigned to the unit stress and to an additional term C which are intended to make the thicknesses computed equitable between materials, after allowing for variations of threading, physical condition, and other factors. The formula is:

$$t_m = \frac{PD}{2S} + C$$

Where t_m = minimum pipe wall thickness in inches allowable on inspection

P = maximum internal service pressure in lb. per sq. in., gage (plus water hammer allowance in case of cast iron pipe for conveying liquids)

D = actual outside diameter of pipe in inches

S = allowable stress in material, in lb. per. sq. in., and

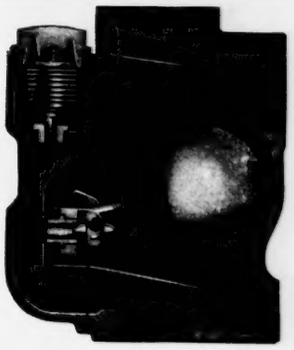
C = allowance for threading, mechanical strength and/or corrosion in inches

Values of C and of S are included in tables incorporated in the code.

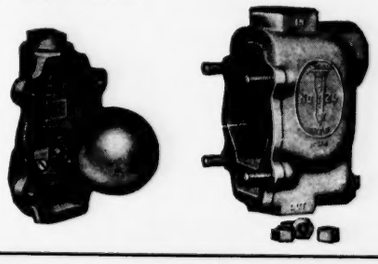
ADSCO

VERTICAL STEAM TRAP

Saves Steam— Simplifies Installation and Maintenance— Outlasts Two Ordinary Traps



FAULTY, inefficient steam traps not only waste the time of maintenance men, they waste steam as well. And steam is money; waste means loss. Here is a new steam trap for pressures to 125 lbs.— so efficient in operation, so simple to install and easy to service that it is the ideal trap for replacement in industries everywhere.



5 FEATURES THAT HAVE OUTSTANDING APPEAL

(1) All working parts are mounted on the cover—piping connections on the body. If a trap needs cleaning, the cover assembly can be replaced with a "spare" in a few minutes without disturbing the connections.

(2) Stainless alloy steel valve and seat are reversible, thereby affording twice the usual life.

(3) In proportion to air and condensate capacities, all sizes of the Adsco Vertical Steam Trap are particularly compact.

(4) It is light enough so that it is supported directly by the piping.

(5) Arrangement of inlet and outlet connections simplifies installation and makes possible unusually neat piping layout.

60 DAYS' FREE TRIAL

We know that once you see the New Adsco Vertical Steam Trap and try it out, you will recognize its exceptional merit. So, for a limited time, we are offering to send you one on 60 days' FREE trial. Send for details NOW.

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NORTH TONAWANDA, N.Y.

OVER FIFTY YEARS IN BUSINESS

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Please send full details of New Adsco Vertical Steam Trap and your 60-day FREE trial offer.

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Air Conditioning, Automatic Heat and Building Gains Feature Business News

(Concluded from page 55)

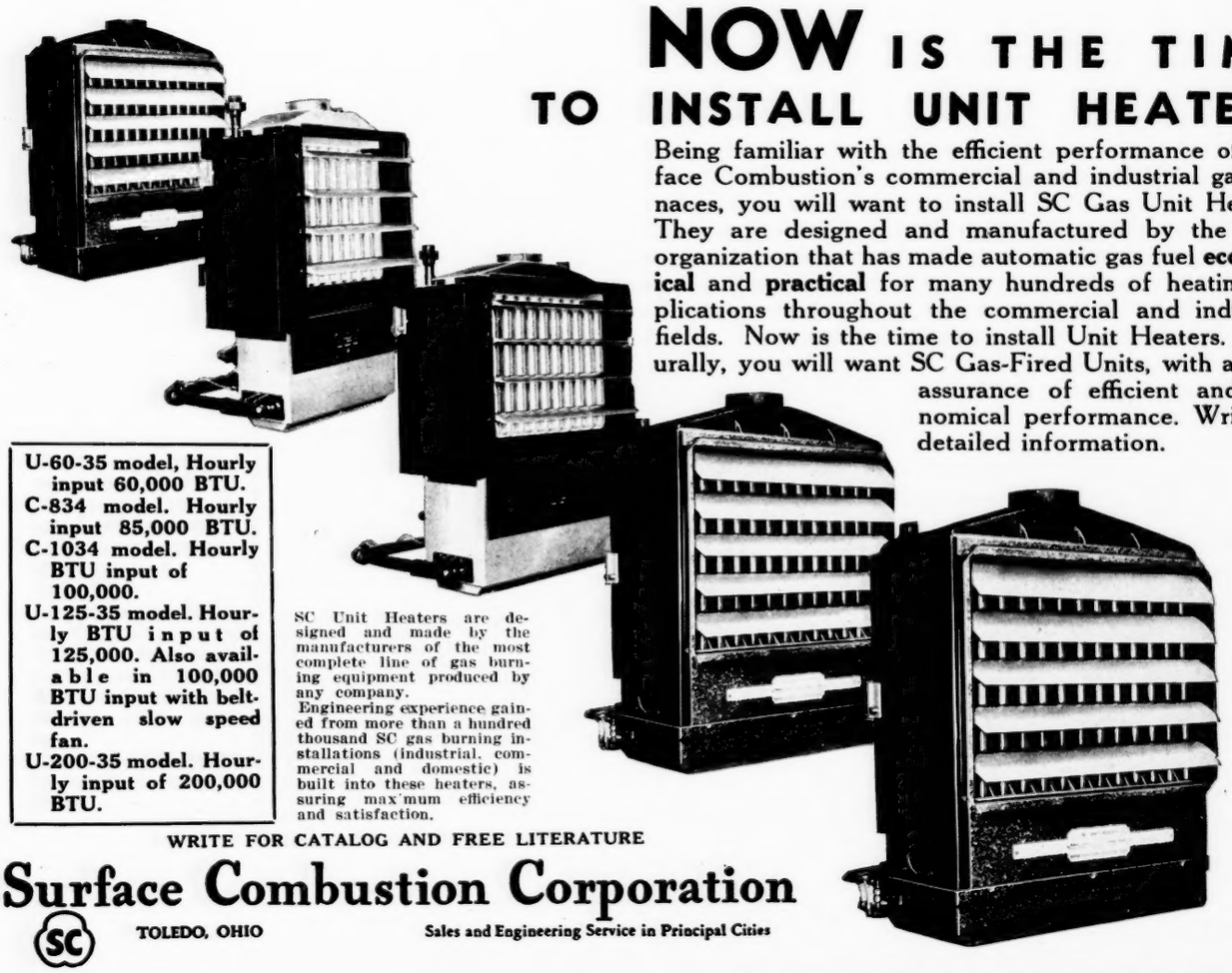
in 61% of the communities. Never since tabulation of these trends was started about ten years ago has so high a proportion of the cities shown an upturn.

Banks and other private lending institutions of the country did a record volume of business in extending modernization credit under the Federal Housing Administration program during the week ending August 3. In that period a new peak of 17,433 insured modernization and repair notes, amounting to a total of $5,401,510 were extended by the thousands of private lending institutions cooperating in the program.

It brought the total business done by the financial institutions in insured modernization and repair notes since the beginning of the program about a year ago to 291,879, amounting to over $114 million.

EQUIPMENT SALES AND HEATING BUSINESS TRENDS.

Equipment	June 1935	June 1934	May 1935
Oil burners, number of units shipped in U. S., mechanical draft type	7783	3847	7507
Boiler-burner units, number shipped in U. S.	837	707	934
Ventilating blowers, orders in dollars	111,716	76,183	109,330
Small housed blowers, orders in dollars	48,872	—	48,866
Air washers, orders in dollars	58,614	45,186	57,644
Industrial air conditioning units, orders in dollars	156,365	195,751	194,017
Industrial unit heaters, orders in dollars	192,731	162,624	218,398
Schoolroom unit ventilators, orders in dollars	187,129	117,362	118,440
Non-ferrous indirect heating surface, orders in dollars	102,598	49,482	96,881
Cast iron indirect heating surface, orders in dollars	10,968	5,992	13,155
Residential stokers, sales in number of units	2,417	904	1,704
Steel boilers, orders in square feet of heating surface	146,322	91,070	356,648
Cast iron round boilers, shipments in thousands of pounds	2,710	2,361	2,493
Cast iron square boilers, shipments in thousands of pounds	10,700	10,029	9,241
Cast iron radiators, shipments in thousands of square feet	3,462	3,197	2,835
Non-ferrous convectors, sales in square feet, elements only	56,280	52,123	49,424
Non ferrous convectors, sales in square feet, with cabinets	147,614	122,055	152,944
Cast iron convectors, sales in square feet	245,870	119,082	209,179
Indexes (1929 = 100), Seasonally Adjusted			
Heating and Ventilating's Index of Heating Business	56.4	41.0	58.7
Heating and Ventilating's Index of Automatic Heating	125.8	65.1	112.8
Heating and Ventilating's Index of Heating Contractor Activity	37.3	35.1	46.6
	July 1935	July 1934	June 1935
New Building Contracts	28.0	17.0	26.0
Heating and Ventilating's Index of Stock Prices, 11 Companies, unadjusted	43.8	26.6	39.0



NOW IS THE TIME TO INSTALL UNIT HEATERS

Being familiar with the efficient performance of Surface Combustion's commercial and industrial gas furnaces, you will want to install SC Gas Unit Heaters. They are designed and manufactured by the same organization that has made automatic gas fuel **economical** and **practical** for many hundreds of heating applications throughout the commercial and industrial fields. Now is the time to install Unit Heaters. Naturally, you will want SC Gas-Fired Units, with all this assurance of efficient and economical performance. Write for detailed information.

U-60-35 model, Hourly input 60,000 BTU.
C-834 model. Hourly input 85,000 BTU.
C-1034 model. Hourly BTU input of 100,000.
U-125-35 model. Hourly BTU input of 125,000. Also available in 100,000 BTU input with belt-driven slow speed fan.
U-200-35 model. Hourly input of 200,000 BTU.

SC Unit Heaters are designed and made by the manufacturers of the most complete line of gas burning equipment produced by any company. Engineering experience gained from more than a hundred thousand SC gas burning installations (industrial, commercial and domestic) is built into these heaters, assuring maximum efficiency and satisfaction.

GAS FIRED

WRITE FOR CATALOG AND FREE LITERATURE

Surface Combustion Corporation

TOLEDO, OHIO

Sales and Engineering Service in Principal Cities

NEW CATALOGS

American Air Filter Company, Inc., Louisville, Ky., is publishing "Dust Engineering," a house organ published quarterly, dealing with dust problems and dust control equipment. The firm will be glad to add the names of any who have need of the company's equipment to their mailing list.

Carrier Engineering Corporation, Newark, N. J., has published the Econograph, a folding 16 x 18 in. chart with tables for determining the investment return on air conditioning. By means of the tables and charts, and knowing the shape of the building, percentage of total rentable floor space rented and the annual rent per square foot, together with owning and operating costs which can be obtained from the tables for various cities, the user can determine how much an investment in air conditioning would yield in office buildings.

The Emerson Electric Mfg. Co., St. Louis, Mo. Furnace blower catalog X573. Standard size, eight-page bulletin describing, illustrating and giving engineering data on the company's line of furnace blowers with air washers and filters.

Inland Steel Co., First National Bank Bldg., Chicago. An envelope size folder devoted to Inland copper-alloy steel and pointing to the va'ue of this product in combating corrosion.

Johns-Manville, 22 East 40 St., New York. No. DS series 275, an illustrated, standard size, 12-page booklet entitled "Sound Control of Mechanical Equipment," featuring methods of deadening or reducing noise produced by mechanical equipment through the use of sound dampening or sound absorbing materials and by isolating vibrating mechanisms. It contains an instructive discussion of the problem of sound control in air conditioning systems, mechanical refrigerators, oil burners and other equipment, as well as a description of the various materials used in typical installations. Special treatment is given the subject of vibration isolation platforms designed for motors, fans, and the like.

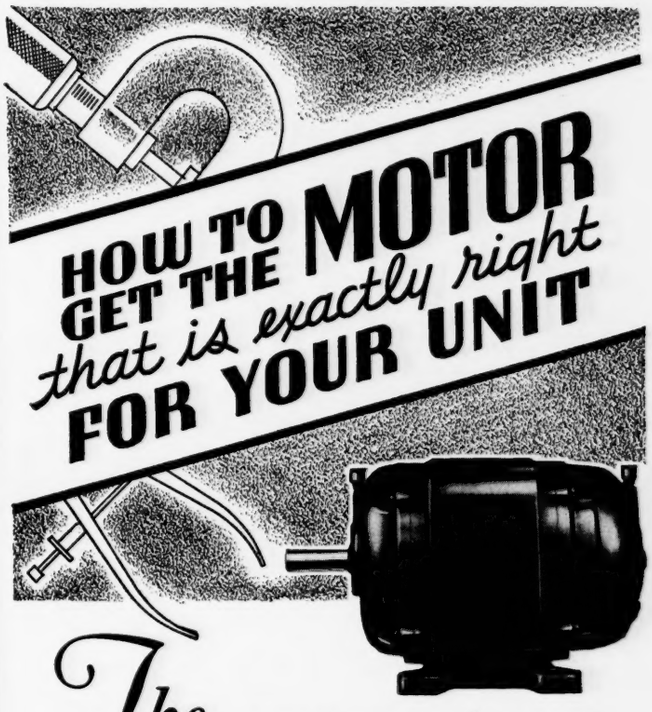
Johnson Fan & Blower Corp., 1319-1325 West Lake St., Chicago. Bulletin 3460, revised, a standard size, 10-page publication devoted to the company's propeller type unit heaters and containing detailed capacity tables and dimensional data. Also a two-page standard size supplement containing a tabulation of the consumer's net price list.

H. W. Porter Co., 825 Frelinghuysen Ave., Newark, N. J. Bulletin 352, containing specifications for a complete Therm-O-Tile system of steam conduits for protection and insulation of pipe lines between buildings. Shows cross sections of typical installations with sectional pipe covering and fi'ler type fibre insulation; a typical plot plan layout furnishing steam to a group of four buildings with conduit sizes, expansion manholes, pipe sizes, elevations and anchor pits; gives details of construction.

Ross Heater & Mfg. Co., Inc., Buffalo, N. Y. Bulletin No. 1039. A 28-page, standard size bulletin in color describing the company's expansion joints. Descriptive and dimensional data are given, together with photographs and drawings. The company has also published a standard size bulletin, No. 1041, in color, on its line of storage tank heaters. It is profusely illustrated with drawings and photographs, and contains engineering data for determining size of fixtures, piping, tanks, and similar information.

Bulletin 1043, entitled "The Ross Decalorator," is a 32-page bulletin, standard size, devoted to the company's line of steam jet refrigerating equipment. Gives typical piping layouts, steam and water consumption tables, complete description of the apparatus, typical specifications and dimensional and other engineering data relating to this product.

H. A. Thrush & Co., Peru, Ind., has published the Thrush flow control sales and engineering manual, a standard size bulletin in color. The bulletin completely describes and illustrates all of the company's line of flow control equipment and includes 11 pages of engineering and installation data.



The correct motor for your heating, ventilating or air-conditioning equipment may require some entirely New Features . . . or special characteristics . . . not available in regular or stock motors.

Our facilities and production set-up are such that Special Motors are designed, tested and produced in large or small quantities in the minimum of time—and our guarantee of satisfactory performance goes with each one. Prices are in line, too.

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Latest Bulletins containing complete Technical Data on motors, specifications and other helpful information, sent upon request.

The* BALDOR *Line Includes:

SINGLE PHASE—Repulsion Induction	⅛ to 7½ H. P.
Capacitor Type	1/30 to 1½ H. P.
Split Phase	1/30 to ½ H. P.
DIRECT CURRENT	¼ to 3 H. P.
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Standard Horizontal and Vertical Motors for all applications. Ball Bearings in all sizes. Sleeve bearing up to 2 H. P.

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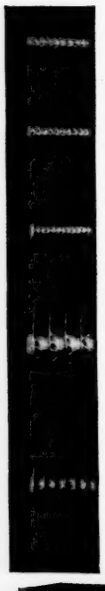
A BETTER MOTOR

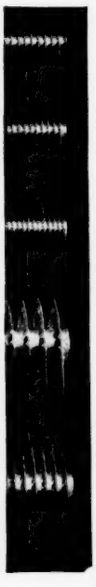
SPECIFY AEROFIN FOR HIGHEST EFFICIENCY



Aerofin Standardized Light Weight Fan System heat exchange surface is the first choice of architects, engineers and building owners for Heating or Cooling because of its proved superiority. Progressive heating and cooling contractors install it because it gives complete satisfaction.

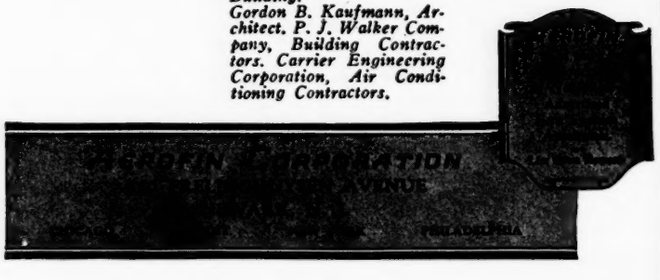
Aerofin is years in advance of ordinary heating and cooling surface because of its exclusive features. It is available in aluminum, copper or other special metals. Whatever you have wished for in a fan system surface you will find in Aerofin.

The home office in Newark or any of our branch offices will gladly send complete descriptive literature or render prompt, personal and efficient technical cooperation. Simply write to the address below.

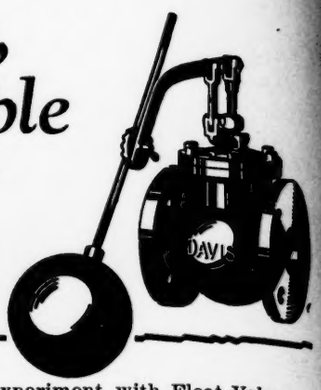


Aerofin Flexitube Unit for Heating or Cooling with water.

Aerofin surface is installed in the Los Angeles Times Building. Gordon B. Kaufmann, Architect. P. J. Walker Company, Building Contractors. Carrier Engineering Corporation, Air Conditioning Contractors.



A Simple, Dependable FLOAT VALVE



THERE is no need to experiment with Float Valves of doubtful design when Davis can give you such a well proven valve. The simplicity of Davis Float Valves means accurate, reliable, trouble-free service! The perfected Davis design is a result of over fifty years' experience in solving every kind of flow control problem.

The Davis is an absolutely tight-closing valve, yet operates freely—sticking is permanently eliminated. Your open tank will never overflow with a Davis Float Valve on the make-up line.

ADVANTAGES—No internal packing—Entirely automatic—Handles hot or cold water at high or low pressure—No hunting—No water-hammer—Renewable composition disc—Visible action—Dependable Service—Globe or Angle pattern.

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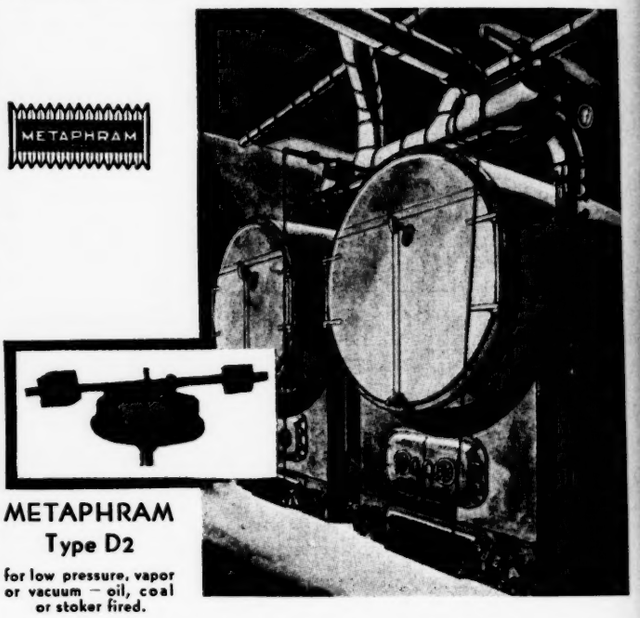

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for low pressure, vapor or vacuum — oil, coal or stoker fired.

METAPHRAM Gradual Control

covers the entire range of domestic hot water and low pressure boilers and tank heaters, either gas, oil or coal fired.

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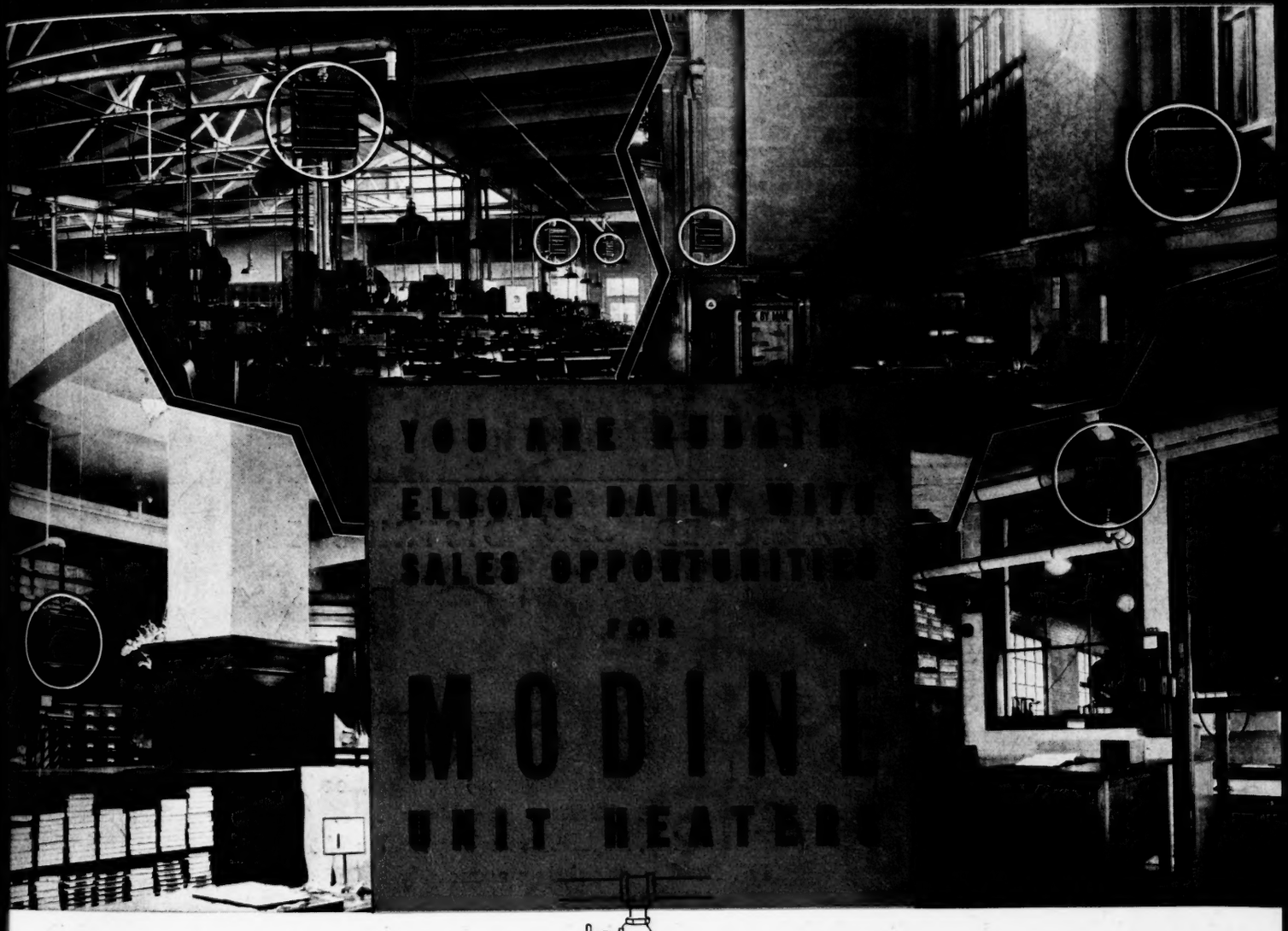

● Retail stores, restaurants, taverns, hotels, vestibules, garages, auditoriums, gymnasiums, school rooms, warehouses, large and small industrial plants —in any place heated with old-fashioned pipe coils or radiators a saving of 13% to 25% in fuel costs can be made by changing to Modine Unit Heaters. And *new* building is picking up, affording another source of business.

● Less time and material are required to install Modine than any other heating unit because of direct pipe suspension. This is only one of several features exclusive to Modine. Find out why more Modines are sold than any other unit heater. Write for New Catalog No. 635 which contains full information on the complete line of Modine Unit Heaters, including new models recently added. Modine Mfg. Co., 1740 Racine St., Racine, Wis.